



The Conference Board
of Canada

Report

Alberta Unbound

Research and Innovation Opportunities in Alberta's Food Sector

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Report: Alberta Unbound—Research and Innovation Opportunities in Alberta’s Food Sector

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The Conference Board of Canada is solely responsible for the content of this document, including any errors or omissions.

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Alberta Unbound: Research and Innovation Opportunities in Alberta's Food Sector

Executive Summary

Project Background and Overview

The competitive landscape in food is changing, and innovation is becoming more important to food industry success. Product and process developments must keep pace with an expanding array of consumer expectations for food that is safe, affordable, convenient, healthy, and sustainable. Food-related scientific and technological advancements open up new possibilities for food innovation to meet these changing demands, and respond to pressures such as rising global competition and input costs.

The food sector in Alberta—including food businesses, researchers, and intermediary associations and facilities—has participated in a variety of food innovation initiatives. Not only have these efforts improved consumers' ability to satisfy their dietary preferences and enhanced food safety and quality, food innovation is also contributing to economic development and diversification in the Alberta economy. But more can be done. There are some areas of food research and innovation where Alberta has opportunities to further differentiate itself and achieve a competitive advantage.

Alberta Innovates Bio Solutions seeks to identify strategic opportunities for future research and innovation investments that would generate value for the province: including economic growth and diversification and improved social outcomes. To assist Alberta Innovates Bio Solutions in achieving these objectives, The Conference Board of Canada conducted research to identify food innovation and industry trends, their alignment to domestic and global market opportunities, and to provide advice on implementing strategies and addressing challenges. The result is a comprehensive assessment of Alberta's food innovation potential.

In particular, this report:

- identifies and analyzes opportunities and challenges for the food industry in Alberta, based on the current and projected domestic and global environments;
- provides a picture of how well the Alberta food sector is meeting emerging trends and opportunities in consumer demand;
- characterizes the state of Alberta's research and industry capacity to seize on emerging trends and opportunities;
- provides a portfolio and economic analysis of possible strategic investments in research and innovation opportunities;
- discusses the potential social impact of investments in research and innovation opportunities—with a focus on health outcomes, including food safety performance;

- examines research and innovation investments in other jurisdictions that have achieved positive impacts, and can provide insights and lessons for Alberta;
- identifies and discusses barriers to consumer adoption of healthier eating habits and how these might be overcome; and
- prioritizes options and makes recommendations for strategic investments that have potential for positive economic and social impact in light of domestic and global trends, the Alberta food sector’s existing capacity, and likelihood of overcoming challenges.

Food Innovation Drivers and Capacity

Many economic and social factors shape the innovation activities of food businesses in Alberta. Demographic trends, including an increasing global population, and an aging and more ethnically diverse domestic population, create demands for more food and new kinds of food products in Canada and around the world. In addition, the competitive environment is changing. Alberta food businesses, particularly in the primary production sector, depend on export markets for business growth, but they face growing competition from low-cost producers in developing countries, and from higher-value producers in the developed world. These and other trends set the broad context within which Alberta’s food businesses make their innovation decisions.

What is Alberta’s capacity to respond to these trends? A broad assessment of Alberta’s research and industry capacity to innovate reveals a sector positioned to achieve greater success in certain areas of focus. The province is an important producer of primary agricultural goods, and contains many research institutions that conduct basic and applied research in a range of food-related fields. These strengths and capacities offer many promising investment opportunities—though innovation performance in the province must overcome several challenges, including a small population and manufacturing base, lagging business motivation to innovate, and low (and in some cases declining) investment into agri-food business.

Emerging Opportunities in Food Innovation

Alberta researchers and businesses are active in a very wide range of food-related research and innovation activities related to both new products and processes, including: food platform technologies; healthy food innovations; functional foods, nutraceuticals, and fortification; food safety innovation; ingredients and value-added opportunities; snacks and indulgence foods; beverages; and packaging. However, these activities do not all hold equal promise as investments able to generate the economic and social returns that Alberta Innovates Bio Solutions seeks.

Using criteria that include the requirements of innovation success (research and industry capacity, and market opportunity), the Conference Board has identified and rated a subset of relevant research and innovation opportunities available to Alberta’s food sector, and identified the most promising investment opportunities for Alberta Innovates Bio Solutions. Given a high degree of market alignment, research and industry capacity, the most promising investment opportunities are in:

- ingredients and value-adding opportunities, particularly in livestock and crops;

- functional foods, nutraceuticals, and fortification, particularly in barley/beta-glucan, functional pulse-based ingredients, and dairy protein; and
- meat safety.

There are also areas of emerging or potential strength, where some research or industry capacity exists alongside market alignment, including:

- biotechnology, particularly genomics applications in crop and livestock production, food safety, and traceability and quality assurance;
- opportunities related to poultry bioactives and choline; and
- food nanotechnology (where there is strong research capacity, but a need to build stronger industry capacity).

Finally, there are two areas that show evidence of strong industry capacity and market opportunity, but where the state of research capacity is weak or unknown (but could be developed), including:

- special dietary needs (e.g., gluten-, dairy-, and nut-free products); and
- potato-and-pulse-based indulgence foods/snacks.

Alberta Unbound – Strategies for Success

With strategic investments in these areas of opportunity, Alberta Innovates Bio Solutions stands to contribute to a higher performing food sector—one that is able to generate more economic and social value for its businesses and citizens. However, it is also important that the province work to develop a more effective food innovation ecosystem, and the self-sustaining food research and business clusters that will position it for long-term success—as other jurisdictions considered in this report have achieved. To this end, we recommend that key stakeholders in the province work towards several additional objectives:

- Improve links between industry and the research community.
- Support national and global-facing initiatives and companies.
- Conduct detailed competitive analyses.
- Support initiatives to improve dietary patterns.

With the right mix of investments and policy strategies, there is every reason to believe that Alberta can realize the abundant food innovation opportunities that are available to it.

Chapter 1

Introduction

Chapter Summary

- There are some areas of food research and innovation where Alberta has opportunities to further differentiate itself, achieve a competitive advantage, and contribute to economic development and diversification, as well as the health and well-being of Albertans.
- The Conference Board of Canada has undertaken research to assist Alberta Innovates Bio Solutions in making food research and innovation investment decisions and to provide advice on implementing strategies and addressing challenges.
- Assessments of Alberta’s research capacity for food innovation must be accompanied by assessments of consumer and demographic trends and commercial capacity as research will have little impact on economic and social objectives unless food businesses develop and sell, and consumers buy and consume, the food products that emerge from research.

Food and food innovation are increasingly prominent concerns among Canadian businesses, governments, researchers, and citizens. Canadians’ food preferences are changing. Many are more aware of the link between food and health and are making efforts to improve their diets. While consumers continue to expect food to be safe, high quality, and affordable, many now also expect it to be convenient, and produced and sold in ethically and environmentally sustainable ways. These trends have prompted many food businesses to research and develop new and improved products that meet consumers’ demands and implement improved processes and technologies. As a recent Conference Board report reveals, although there is room for improvement, the Canadian food industry has produced substantial economic and social value through innovation.¹

The food sector in Alberta—including food businesses, researchers, and intermediary associations and facilities—has participated in a variety of food innovation initiatives. Not only have these efforts improved consumers’ ability to satisfy their dietary preferences and enhanced food safety and quality, food innovation is also contributing to economic development and diversification in the Alberta economy. But more can be done. There are some areas of food research and innovation where Alberta has opportunities to further differentiate itself and achieve a competitive advantage, including opportunities in healthy food; food safety; platform technologies; processing and packaging; and food ingredients, products, beverages and supplements.

Seizing these opportunities and achieving maximum benefits, however, will require strategic investments and action. This, in turn, requires a strong foundation for decision-making, including having a clear picture of domestic and global trends in consumer behaviour, an understanding of the competitive context and regulatory environment, and a detailed account of the capacity of

¹ Conference Board, *Competing for the Bronze*, 19.

Alberta food researchers and businesses to seize opportunities. This report is intended to contribute to the future of Alberta’s food sector by providing that foundation.

Purpose of the Report

Alberta Innovates Bio Solutions aims to identify strategic opportunities for future research and innovation investments that would advance the aims of improving the food supply to meet consumers’ needs and preferences, while also contributing to economic development and diversification. The Conference Board of Canada has undertaken research and prepared this report to assist Alberta Innovates Bio Solutions in making investment decisions and to provide advice on implementing strategies and addressing challenges.

In particular, this report:

- identifies and analyzes opportunities and challenges for the food industry in Alberta, based on the current and projected domestic and global environments;
- provides a picture of how well the Alberta food sector is meeting emerging trends and opportunities in consumer demand for food including opportunities in healthy food; food safety; platform technologies; processing and packaging; and food ingredients, products, beverages and supplements;
- characterizes the state of Alberta’s research and industry capacity to seize on emerging trends and opportunities;
- provides a portfolio and economic analysis of possible strategic investments in research and innovation opportunities;
- discusses the potential social impact of investments in research and innovation opportunities—with a focus on health outcomes, including food safety performance;
- examines research and innovation investments in other jurisdictions that have achieved positive impacts, and provide insights and lessons for Alberta;
- identifies and discusses barriers to consumer adoption of healthier eating habits and how these might be overcome; and
- prioritizes options and makes recommendations for strategic investments that have potential for positive economic and social impact in light of domestic and global trends, the Alberta food sector’s existing capacity, and likelihood of overcoming challenges.

Framework

As Alberta Innovates looks to make strategic investments that could advance the aims of economic development and diversification, as well as producing a healthy, safe, and affordable food supply aligned with consumer preferences, it is necessary to understand how these aims are related and how stakeholders perceive the opportunities and challenges. The report’s analysis is informed by the recognition that only research which is of interest to, or aligns with, the present or future needs of businesses and consumers will have an economic or social impact.

To be sure, businesses and consumers often fail to recognize the value of research that they ought to value, and incorporate it into products very slowly, if at all. Yet, the fact remains that until research is perceived to have value by these stakeholders, it will have little to no impact on economic and social objectives. In other words, research insights must be commercialized or implemented in order to create economic and/or social value—a necessary criterion for successful innovation.

Consequently, assessments of Alberta’s research capacity for food innovation must be accompanied by assessments of consumer and demographic trends and commercial capacity. Whatever the strengths of Alberta’s food research community, it is necessary to consider whether there is consumer and business demand for that research or whether such demand could realistically be generated. Thus, the report pays close attention to both the research supply and consumer/business demand sides of the issue and places higher priority on strategic investments in areas where there is greater alignment (or potential alignment) between the two.

An Illustration: Supply and Demand in Healthy Food Research and Innovation

Healthy food innovation provides a practical illustration of the issues. Alberta Innovates’ *Quality Food for Health* Program sets out the dual goals of improving “the health and well-being of Albertans while increasing the competitiveness of the province’s food and agricultural industries.”² These goals are reinforced in *Making the Food Health Connection: Alberta’s Food and Health Innovation Framework*, which articulates a two-pronged vision that:

- Albertans benefit from producing and eating food that makes them healthier; and
- Alberta businesses participate in the global market place for healthy food products.³

Simply put, the approach is to stimulate innovation in Alberta’s food industry to improve the health and quality of the food supply and simultaneously to achieve economic growth and employment.

Although a “convergence of consumer demand and supply of healthy products”⁴ is possible—and some businesses have been successful in offering healthy food innovations—careful study reveals significant challenges to aligning research and commercial activities to achieve both health and economic benefits. The Conference Board’s recent report on food and chronic disease notes that the food industry is motivated primarily by economic considerations, such as increasing profits and market share. While consumer demand for healthier food has grown, “the reality is that most consumers demand *both* healthy and unhealthy options.”⁵ As a result, food businesses have an incentive to produce some unhealthy food as well as healthy food. To be sure, food businesses can shape consumer demand to some degree, but only on an incremental basis. A business that gets too far ahead of existing trends will find itself facing serious risks very quickly.

² Alberta Innovates Bio Solutions, *Highlights Report 2012*, 9.

³ Alberta Life Sciences Institute, *Making the Food-Health Connection*, iii.

⁴ Alberta Life Sciences Institute, *Making the Food-Health Connection*, 5.

⁵ Conference Board, *Improving Health Outcomes*, 40.

In considering which research and innovation investments have the greatest potential to meet both economic and social goals with respect to food, then, the report is attentive to economic realities. In particular, it examines trends in consumer demand, product development, and new technologies with eyes both on *research* and *commercial* opportunities and capacity, and places higher priority on strategic research investments in areas where there are opportunities for genuine alignment.

Balancing Economic, Health, and Environmental Priorities

It is also important to note at the outset that health and other social objectives—such as reducing rates of chronic diseases or minimizing the environmental impact of food production—might not be achieved through product or process innovation alone, but might also require some policy innovation. In the case of health outcomes, for example, although reducing potentially harmful ingredients (e.g., trans fats, sodium, and certain sweeteners) in processed foods is worthwhile, other strategies may achieve greater impacts. Dramatic improvements in health outcomes could be achieved if more consumers ate 5 to 10 servings of fruit and vegetables per day. This would require significant policy and behavioural changes, but less so product or process innovation by businesses (with the exception of improvements to supply chain logistics).

The point is that much of the higher economic value innovation that can be supported through investments in research may not produce the highest health/social value that could be achieved through different spending priorities. Nevertheless, if economic development and diversification are key priorities, then it may be necessary to settle for second-best, rather than ideal, health and social outcomes.

Methodology

The research involved a multi-faceted methodology:

- An extensive literature review focused on domestic and global trends in consumer food demand; domestic and global developments in food science and innovation; capacity and developments in Alberta’s food sector; and, in the case of the relationship between food and health outcomes, a focus on what is known about the determinants of consumer food choices and dietary patterns.
- Insights were obtained through 74 in-depth interviews with:
 - business leaders and managers in the food industry, including CEOs in large multinationals and small and medium enterprises (34);
 - industry association representatives (15);
 - researchers in academia, food innovation experts, and researchers in other organizations (12);
 - government representatives in relevant Alberta and federal agencies (5); and
 - international businesspeople, researchers, and experts involved in food innovation initiatives which provide lessons for Alberta (8).
- Quantitative findings from the Conference Board’s Centre for Food in Canada Industry Survey were obtained and analyzed (see textbox below);

- Additional data from multiple sources were obtained to assist in developing a picture and assessment of Alberta’s food research and commercial capacity, including data about:
 - the number and size of companies engaged in food innovation in Alberta;
 - the size of the market;
 - domestic and global market share; and
 - research and development (R&D) intensity (including R&D spending and employment of researchers).
- A portfolio and economic analysis of strategic opportunities.
- An analysis of the potential social impact of strategic opportunities.
- Scan and analysis of research and innovation investments in other jurisdictions that have achieved positive impacts.

About the Centre for Food in Canada’s Surveys

A key mandate of The Conference Board of Canada’s Centre for Food in Canada is to generate insights about the food system from both the perspective of industry and households. The achievement of this mandate requires the Centre to gather proprietary data on the specific challenges facing Canada’s food industry and Canadian households’ food-related skills, attitudes and behaviours. To this end, we designed and executed, firstly, a business survey of the Canadian food industry and, secondly, a survey of Canadian households. These surveys were conducted by Forum Research—a Toronto-based survey company.

For the industry survey, Forum Research randomly surveyed 1,186 food companies during June 23-July 22, 2011, using questions prepared by The Conference Board of Canada. Companies were sampled according to 3-digit North American Industrial Classification System (NAICS) codes 445 (retail food distribution), 311 (food processing), 111 (crop production), and 112 (animal production). 1,177 of the surveys were telephone surveys conducted by trained interviewers, and 9 were filled in by hand and submitted in hard copy form. The survey produced responses by 890 firms with 1-19 employees, 140 with 20-99 employees, 26 with 100-499 employees, and 16 with 500 or more employees. (The remainder did not specify the number of employees). Aggregate survey findings are considered accurate +/- 2.85 per cent, 19 times out of 20.

For the household survey, Forum Research randomly surveyed 1,056 Canadian households during September 8-11, 2011, using questions prepared by The Conference Board of Canada. In this case, aggregate survey findings are considered accurate +/- 3.02%, 19 times out of 20. Subsample results have wider margins of error for both surveys.

Where possible, the current report pulls out and analyzes Alberta-specific results from both surveys. The industry survey included 165 Alberta-based responses. The household survey received responses from over 150 Alberta households. With smaller samples, the Alberta-specific analyses entail higher margins of error and thus are reported with caution.

Structure of the Report

Following this introduction, Chapter 2 examines food innovation drivers and focuses on trends in consumer demographics and preferences—at both the global and domestic levels—that create opportunities and challenges for the Alberta food sector. Additionally, it examines changes in the competitive context, regulatory environment, and the importance of food science and technology to food innovation. Chapter 3 explores in broad outline the commercial and research capacity of the Alberta food sector to pursue innovation opportunities and identifies key challenges to achieving economic and social (e.g., health) objectives, including regulation and consumer receptivity and behaviour.

With this background in place, Chapter 4 describes specific food innovation opportunities for Alberta. Each opportunity description includes an investigation of what is occurring in the province and a preliminary assessment of the capacity of Alberta’s food sector to pursue it. Chapter 5 offers portfolio, economic, and social impact analyses of a subset of candidate investment opportunities, and identifies the most promising opportunities for Alberta. Chapter 6 presents three in-depth profiles of food research and innovation initiatives in other jurisdictions which provide lessons to Alberta stakeholders. Finally, Chapter 7 offers recommendations about strategic investment options as well as strategies for successful implementation to achieve best outcomes.

Chapter 2

Food Innovation Drivers

Chapter Summary

- Demographic and other changes are creating both challenges and opportunities for food researchers and businesses in Alberta and elsewhere.
- Rising global competition and input costs, as well as increasing concerns about food safety, create additional pressure for food businesses to innovate.
- Although regulation in Alberta and Canada can create incentives to innovate in key areas—such as food safety, healthy food, and sustainable production—requirements related to health claims and other areas can also limit or impair food innovation.
- To reap the full benefits of food research and innovation investments, Alberta should look at global, and not simply domestic, market opportunities.

There are many developments in food science and technology that could improve the health, safety, quality, and affordability of food. But whether those developments are actually commercialized and consumed depends on consumer demand and how businesses choose to respond. Understanding food research and innovation in Alberta, and making decisions about the specific areas in which investments should be made, then, requires that we examine the underlying drivers of food innovation and commercialization. What are the macro-level changes in consumer preferences at the global, Canadian, and provincial levels? What opportunities and challenges emerge from developments in the competitive context and food science? And how do changes in the regulatory environment affect the innovation decisions of food businesses?

I. Consumer Trends

Food innovation in Alberta, Canada, and globally is driven primarily by changes in the consumer market—particularly demographic changes that affect consumers’ food requirements and preferences that shape what consumers buy and consume. Although opportunities for food innovation can emerge from researchers and businesses whose new ideas may achieve market acceptance, the reality is that a consumer market must either exist or be created for these innovations to achieve commercial success. Consequently, a fruitful approach to identifying and assessing research and innovation opportunities in the food sector in Alberta begins with an examination of consumer trends and the commercial responses to those trends.

Global Demand

Global demand for food is accelerating. By 2050 the world’s population is expected to reach 9.6 billion from its current 7 billion, with most of the increase occurring in the developing world.⁶ At the same time, incomes in the developing world will rise—especially among the emerging

⁶ United Nations, *World Population Prospects*, 1.

middle classes—resulting in increased demand for protein and higher-value foods and weakening demand for starch-based foods. According to some experts, food production will have to increase by 70 per cent to meet rising demand.⁷

Feeding an additional two billion people—and feeding them what they want—creates both challenges and opportunities for the food industry.⁸ Developing countries will increase and alter production to meet changing demand, but they will continue to depend on imports from countries like Canada who, in turn, will face growing market opportunities in the developing world. Whether Canadian—and especially Albertan—food producers are interested and capable of seizing those opportunities is an open question.

Key Markets and Exports for Alberta

Looking at trends in key markets and Alberta’s recent track record in engaging with these markets reveals some interesting trends which may have implications for research and innovation investments. In 2012, Alberta had agri-food exports of an estimated \$9.2 billion which included \$5.5 billion in primary commodities (e.g., animals and crops) and \$3.7 billion in value-added products (i.e., manufactured products).⁹ While total agri-food exports have more than doubled over the past decade (from \$4.1 to \$9.2 billion), growth in primary commodity exports (\$1.6 to \$5.5 billion) is more than triple the growth from value-added exports (\$2.3 to \$3.3 billion).¹⁰

Nearly all of the growth in Alberta’s primary commodities exports comes from wheat and canola, while exports of cattle have remained stagnant. In particular, between 2003 and 2012 exports of *wheat* more than tripled from \$0.7 billion to \$2.3 billion. Exports of *canola seed* witnessed a more than six-fold increase, from \$0.3 to \$1.9 billion. And exports of *live cattle* were variable, due to a number of factors (including the BSE incident), but remained in 2012 what they had been in 2002—\$0.6 billion.¹¹ In the value-added category, growth in exports of products from grain and oilseed milling was strong (\$0.4 billion in 2002 to \$1.3 billion in 2012), while exports of value-added meat products (including beef, pork, horse, other, and processed meats) *declined* from \$2.1 to \$1.6 billion.¹² Thus, while animals and meat remain very important parts of Alberta’s export mix in both the primary and value-added categories, wheat and canola are now the province’s top export products.

Part of the growth has been a result of increased exports to the United States (an additional \$948 million over the past decade), but the majority has come from exports to China, Japan, and Mexico. South Korea has also played a role but wild variation over the past decade makes it difficult to predict what will occur in the future. (See Chart 1, “Alberta Agri-Food Exports – Top Five Destination Countries”).

⁷ Food and Agriculture Organization of the United Nations (FAO), *How to Feed the World in 2050*, 1.

⁸ Conference Board, *Competing for the Bronze*, 7.

⁹ Government of Alberta, *Agri-Food Exports—Alberta 2003-2012*, 2.

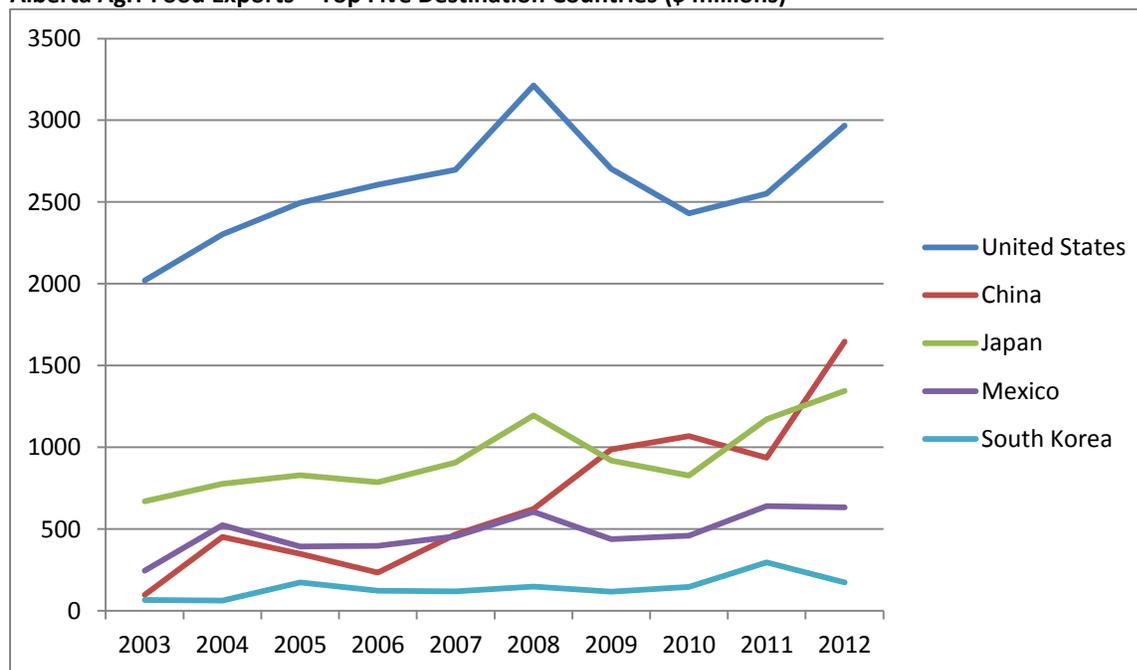
¹⁰ Government of Alberta, *Agri-Food Exports—Alberta 2003-2012*, 2.

¹¹ Government of Alberta, *Agri-Food Exports—Alberta 2003-2012*; Government of Alberta, *Alberta’s International Exports by Industry*. Note that we use 2002 rather than 2003 as a base year in order to get a pre-BSE incident baseline.

¹² Government of Alberta, *Agri-Food Exports—Alberta 2003-2012*; Government of Alberta, *Alberta’s International Exports by Industry*.

Chart 1

Alberta Agri-Food Exports – Top Five Destination Countries (\$ millions)



Source: Government of Alberta.

- United States.* Alberta’s agri-food exports to the U.S. have grown steadily over the past decade, but almost exclusively in primary commodities rather than value-added goods. Between 2003 and 2012, exports of live cattle rose from \$196 to \$588 million, wheat from \$10 to \$281 million, and canola seed from \$12 to \$93 million. Exports of beef (fresh, chilled, frozen) declined from \$909 to \$581 million, while canola/mustard oil (refined) grew from \$62 to \$171 million to become Alberta’s second most valuable manufactured food export (after beef) to the U.S.¹³
- China.* Alberta’s exports to China exploded from \$97 million to \$1.6 billion owing in large part to demand for canola (both primary and value-added products). Since 2003, growth in Alberta’s primary commodity exports to China has occurred mainly in canola seed (\$29.6 to \$673.1 million), but also barley (\$7.8 to \$40 million), wheat (\$12.7 to \$74.3 million), and dried peas (\$93 thousand to \$75.6 million). In the value-added category, Alberta’s exports of canola/mustard oil (refined) have grown from \$14 million to a staggering \$565 million since 2003, while oilseed cake and meal has increased from virtually nothing to \$56.4 million.¹⁴
- Japan.* Although China overtook Japan as Alberta’s second most important export market, it nevertheless received over \$1.3 billion in Alberta agri-food products in 2012 and has seen total growth of over 100 per cent since 2003. Eighty per cent of that growth has been in primary commodities, especially wheat (\$74 to \$220 million) and canola (\$178 to \$537 million). Although pork (fresh, chilled, frozen) remains the top value-added export to Japan

¹³ Government of Alberta, *Agri-Food Exports—Alberta 2003-2012*.

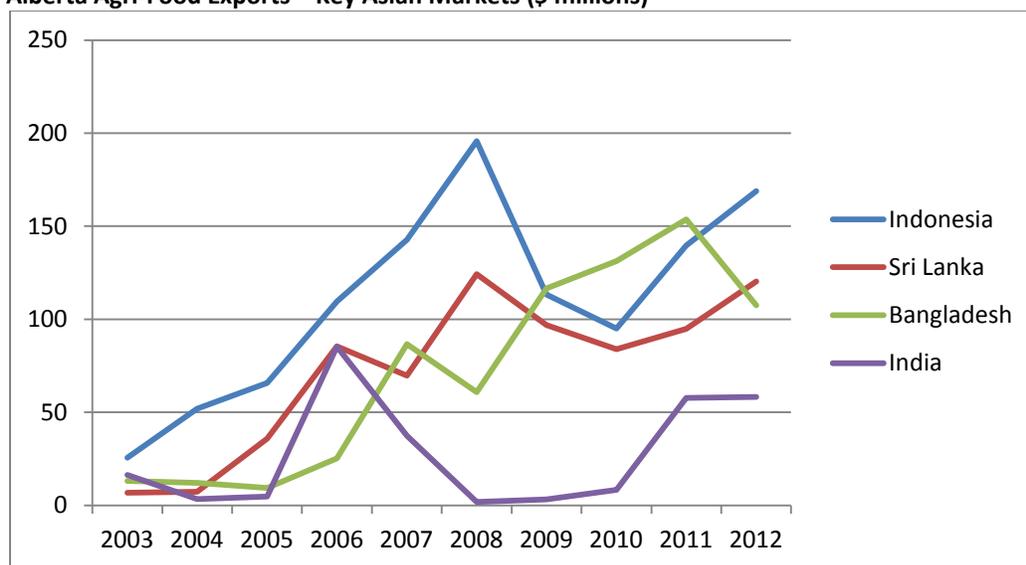
¹⁴ Government of Alberta, *Agri-Food Exports—Alberta 2003-2012*.

(\$179 million) it has seen no growth over the past decade. Some growth has been seen in processed meats (\$2 million to \$18.1 million) and tallow (\$725 thousand to \$48.2 million).¹⁵

- *Mexico*. Primary commodity exports to Mexico have increased fourfold since 2003 (from \$113.1 to \$482 million), but exports of value-added products have been virtually stagnant, increasing from \$133 million to \$141 million. Nearly all growth has been in canola seed (\$62.3 to \$345.5 million) and wheat (\$48.3 to \$123 million).¹⁶
- *South Korea*. Receiving \$174 million in agri-food exports (versus \$67.3 million in 2003), South Korea rounds out the top five markets for Alberta. With growth from \$6.4 to \$56 million between 2003 and 2012, exports of wheat lead the way in primary commodities, followed by hay and fodder (\$1.8 to \$8.5 million) and canola seed (\$71 thousand in 2005 to \$7.1 million in 2012). Nearly all growth in value-added exports came from pork (fresh, chilled, frozen), rising from \$3.8 million to \$35.2 million over the past decade. Exports of malt, canola/mustard oil, and others oils have also grown, though they make up a small share of overall exports to South Korea.¹⁷

Other markets in South Asia are becoming increasingly important. (See Chart 2, “Alberta Agri-Food Exports – Key Asian Markets”). Indonesia and Bangladesh have witnessed their share of Alberta’s agri-food exports rise significantly over the past decade, albeit with a dip during the recession. With populations of 240 million and 160 million, respectively, Indonesia and Bangladesh could become even more important markets for Alberta. Although Sri Lanka’s population (at roughly 20 million) is only a fraction of these other countries, its proximity to these markets along with rapid growth makes it another important target destination.

Chart 2
Alberta Agri-Food Exports – Key Asian Markets (\$ millions)



Source: Government of Alberta.

¹⁵ Government of Alberta, *Agri-Food Exports—Alberta 2003-2012*.

¹⁶ Government of Alberta, *Agri-Food Exports—Alberta 2003-2012*.

¹⁷ Government of Alberta, *Agri-Food Exports—Alberta 2003-2012*.

With a population over 1.2 billion and a rising middle class, India is obviously another key market to watch in the region. However, Alberta’s exports to the country have not yet taken off to the extent that one might expect. Still, there is enormous potential which should be examined.

Canadian Demand

Changes in Canadian consumers’ needs and preferences also create innovation challenges and opportunities. In addition to demographic changes, Canadians’ food preferences have evolved in recent years with implications for the kinds of foods that businesses can sell, as well as the ways in which they produce it. Four categories of major demographic and preference trends at the national and provincial (i.e., Alberta) levels are considered below.

A key point to consider at the outset is that Alberta is a very small market. Although population growth in the province has been strong, Alberta’s total population is less than 4 million.¹⁸ And it is more geographically dispersed than in other provinces with strong food sectors—a key distribution issue for food businesses. According to a recent Conference Board analysis, total expenditure on food in Alberta amounts to just over \$10 billion, with only \$3.839 billion of that remaining in the province.¹⁹ To be sure, Alberta-based producers do not, nor should they, limit themselves to selling in the Alberta market, but given that it is the most proximate market for these businesses, it is important to understand how it affects their innovation opportunities.

1. An Aging Population

Canada’s aging population has important effects on consumer demand for food. The proportion of Canadians over 65 is increasing which may lead to reduced domestic demand as the elderly require fewer calories than younger people. At the same time, because seniors will likely demand healthier foods and foods that help them manage common chronic diseases, there may be opportunities for food innovators to offset declining caloric needs with higher-value, healthier foods.²⁰ Interviews conducted with large food businesses revealed that this is a fast-growing area of focus. These larger businesses are actively developing products specifically for the elderly and/or exploring additional benefits of their existing products for the elderly (with a view towards highlighting these benefits in marketing).

Although Alberta’s population is aging, it nevertheless has a younger population than much of the rest of Canada. By 2012, nearly 15 per cent of all Canadians were 65 or over versus only 11 per cent of Albertans.²¹ (See Chart 3, “Albertans Younger than Other Canadians”). This difference introduces some nuance into Albertan food businesses’ opportunities. Although aging is a reality in Alberta, the size and growth of this opportunity will lag other provinces. Combined with a population of fewer than 4 million, Alberta food businesses that want to grow, especially in niche areas related to aging, will need to look outside the province for markets. Research and innovation investments with the greatest impact will likely be those that focus on innovations and businesses who are looking to national and global markets, rather than Alberta alone.

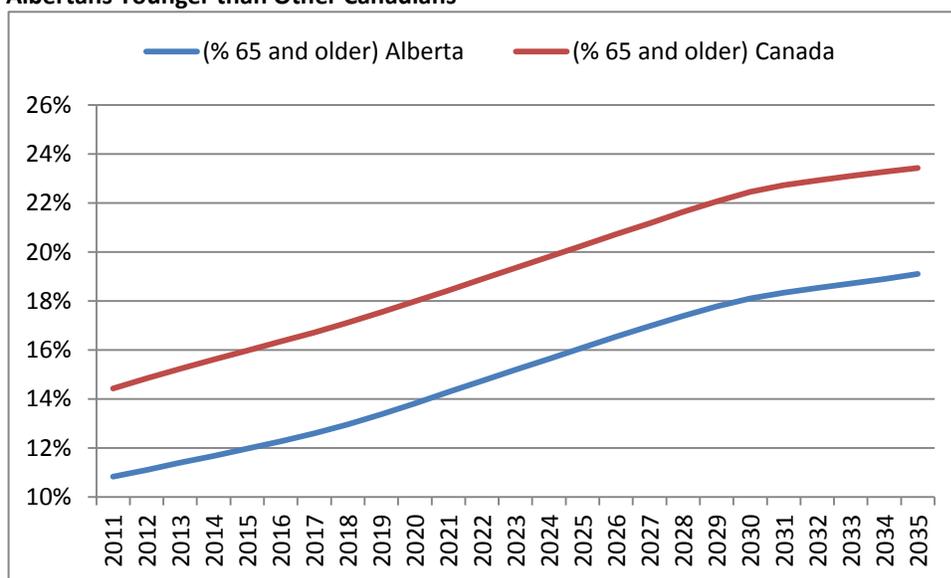
¹⁸ Statistics Canada, *Estimates of population, Canada, provinces and territories*.

¹⁹ J. Edge, “Local Food Systems in Canada.”

²⁰ Conference Board, *Competing for the Bronze*, 6.

²¹ Statistics Canada, *Population estimates, age distribution and median age*.

Chart 3
Albertans Younger than Other Canadians



Source: Statistics Canada

2. Ethnic Diversity

The increasing size and diversity of ethnic minorities in Canada also affects food innovation opportunities. Within five years, ethnic minorities are expected to constitute over 20 per cent of the Canadian population and contribute an estimated 70 per cent of the growth in consumer spending from 2010 to 2020.²² Not only do the dietary needs and preferences of newer Canadians create innovation challenges and opportunities for food business, so too does the increasing interest in ethnic and ethnic-inspired foods among other Canadians.²³

Interviews with food processors and large retailers revealed that developing products and marketing to meet ethnic demand is another key focus. Loblaw’s acquisition of the T&T supermarket chain is perhaps one of the clearest signals that food businesses are increasing efforts to appeal to ethnic markets.²⁴

While Alberta ranks third of all provinces in terms of the proportion of ethnic minorities (16.2 per cent), it falls below the Canadian average of 19.8 per cent and well behind Ontario (28.3 per cent) and BC (27.5 per cent) where ethnicity plays a larger role in shaping food innovation opportunities.²⁵ As with Alberta’s slightly different profile with respect to aging, its profile with respect to ethnicity introduces some nuance into food innovation strategies. Again, investments with the greatest impact will likely be those that focus on national and global markets rather than Alberta alone.

²² Conference Board, *Valuing Food*, 44.

²³ Conference Board, *Competing for the Bronze*, 6. See also Lunau, “Tomorrow’s Food.”

²⁴ Conference Board, *Competing for the Bronze*, 6; Conference Board, *Valuing Food*, 34-5.

²⁵ Statistics Canada, *Canada Yearbook 2011*, 186.

3. *Time and Family Constraints*

Changes in family structure, work patterns, and the time constraints that consumers face are also driving food innovation. With limited time to buy and prepare food, consumer demand for convenient, but healthy, food options is on the rise. Not only did the proportion of dual-earner households with children increase from 31 to 67 per cent between 1976 and 2008, but employment hours for couples rose from 58 to 65 hours per week over the same period.²⁶ As more Canadians work, and work longer hours, they have less time to prepare nutritious meals for their families. This creates opportunities for the food industry to produce and sell more convenience foods—with the caveat that consumers are demanding that convenience foods be healthy. Indeed, even as firms develop and offer more ready-to-eat or on-the-go meals, they are pressured to make such offerings are healthier than they have been in the past.

4. *Evolving Preferences*

The food preference landscape has become increasingly complex and crowded in recent years. Just as consumers are learning more about food and developing preferences related to ethical, environmental, and other social concerns, their expectations with respect to safety, nutritional value, quality, and price have become entrenched preferences. This creates opportunities for innovation in a variety of areas as many consumers are willing to pay a premium for free-range, fair trade, organic, locally-produced, and environmentally sustainable products. Although these rank as lower priorities in the aggregate, there are market niches of sufficient scale to make them worthwhile areas for some businesses to pursue.

At the same time, businesses aiming to seize opportunities in emerging or niche areas find that consumers actually want both their entrenched and emerging preferences satisfied. For example, many consumers want *affordable* organics, *healthy* convenience foods, and *high-quality* fair trade products. Moreover, food safety is a baseline expectation. In light of recent food safety incidents, consumers have been quite vocal in demanding that food be safe. However, there has also been consumer resistance to certain technologies and processes that promise to enhance food safety—such as high pressure processing, irradiation, and genetically modified crops that can reduce pesticide use.

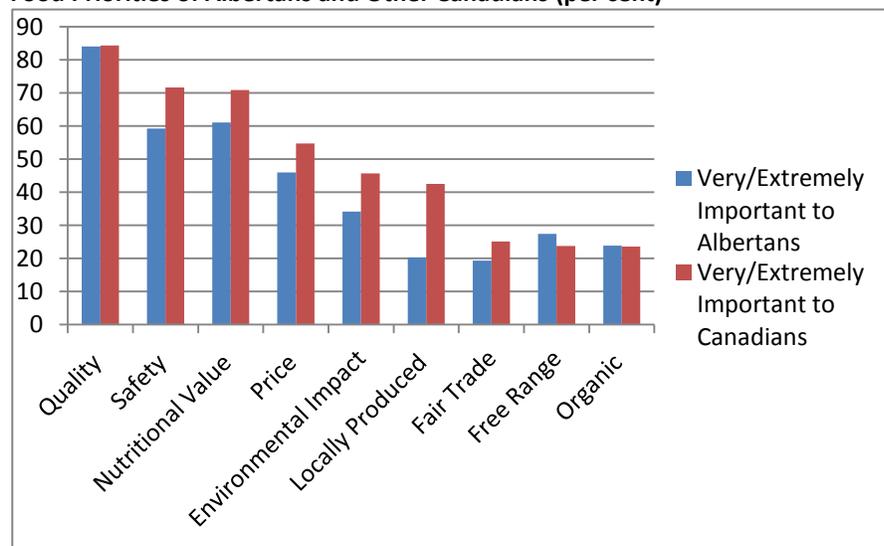
There are also some important differences in Albertans’ food preferences and priorities relative to the rest of Canada. (See Chart 4, “Food Priorities of Albertans and Other Canadians”). Province-level results from the Conference Board’s Centre for Food in Canada survey reveal that Albertans share a desire for high-quality, safe, and nutritious food, but that fewer Albertans rate these priorities as very or extremely important than other Canadians.

While 72 per cent of Canadians regard food safety as a very or extremely important priority, only 59 per cent of Albertans do. Similarly, although 71 per cent of Canadians regard the nutritional value of food as a very or extremely important priority, this falls to 61 per cent among Albertans. Among priorities that receive low ratings by all Canadians, Albertans rate them of even lower importance still. Nearly half (46 per cent) of Canadians regard the environmental impact of food as very or extremely important to their purchasing decisions, but just a third (34 per cent) of

²⁶ Conference Board, *Competing for the Bronze*, 6; Conference Board, *Valuing Food*, 7.

Albertans share that perspective. And while 43 per cent of Canadians rate local production as a very or extremely important consideration, only 20 per cent of Albertans make it a high priority.

Chart 4
Food Priorities of Albertans and Other Canadians (per cent)



Source: The Conference Board of Canada, Centre For Food in Canada Household Survey.

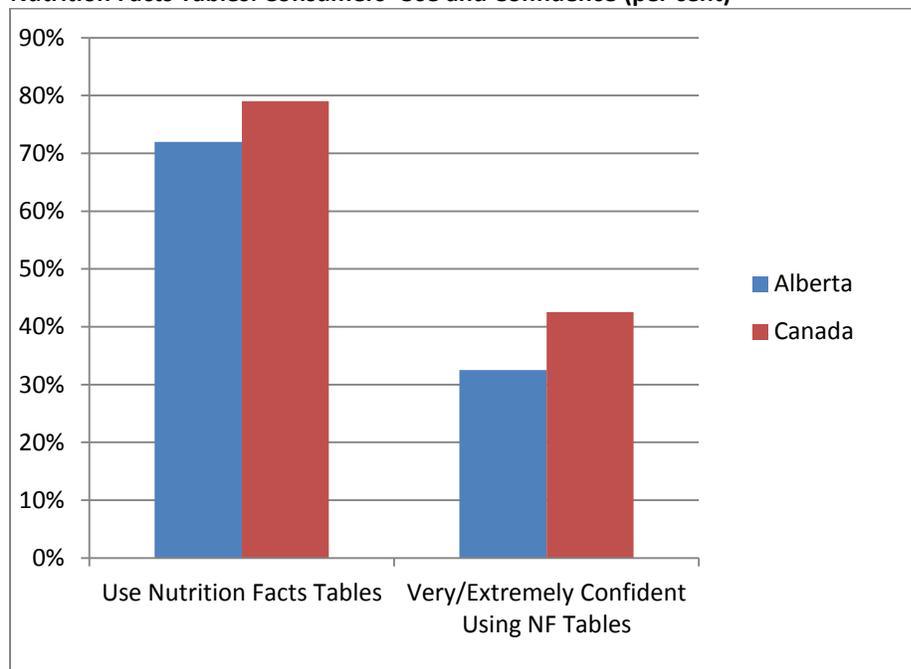
Albertans are also least likely of all Canadians to examine Nutrition Facts Tables before making purchases. Over 79 per cent of Canadians say that they examine the Nutrition Facts tables versus less than 72 per cent of Albertans. Moreover, respondents from Alberta are also less likely than most Canadians to say they are very or extremely confident about using Nutrition Facts Tables. Approximately 33 per cent of Albertans say they are very or extremely confident versus 43 per cent of other Canadians. (See Chart 5, “Nutrition Facts Tables: Consumers’ Use and Confidence”).

These results imply that food innovators focused on Alberta consumers will find that some niche markets are smaller than is the case elsewhere in Canada. To be sure, Albertans expect the same high quality food as other Canadians—both samples reveal 84 per cent support for quality as a very or extremely important food priority—but they may be less enthusiastic about innovations related to health, environmental sustainability, local production, and fair trade.

Keeping in mind that the Alberta sample of the survey entails a larger margin of error than the survey as a whole, the differences are nevertheless significant enough to have implications for investment decisions—at least when considered from a consumer market perspective. (The competitive context and regulatory environment may entail different considerations). Taking a national or global perspective, the full spectrum of research investments should be on the table. However, if the businesses that would develop and commercialize the research results have merely provincial, rather than regional, national, and/or global market ambitions, then a cautious, incremental approach may be prudent in the case of research oriented to anything other than quality innovation. Given that Alberta’s market is small, it is highly advisable for research and investment opportunities to consider national and global market trends, and for Alberta food businesses to focus on growth beyond the province. Still, many food businesses will also want to

achieve success domestically first and, in that case, will want to be attentive to Alberta-specific trends to some extent.

Chart 5
Nutrition Facts Tables: Consumers’ Use and Confidence (per cent)



Source: The Conference Board of Canada.

II. Competitive Context

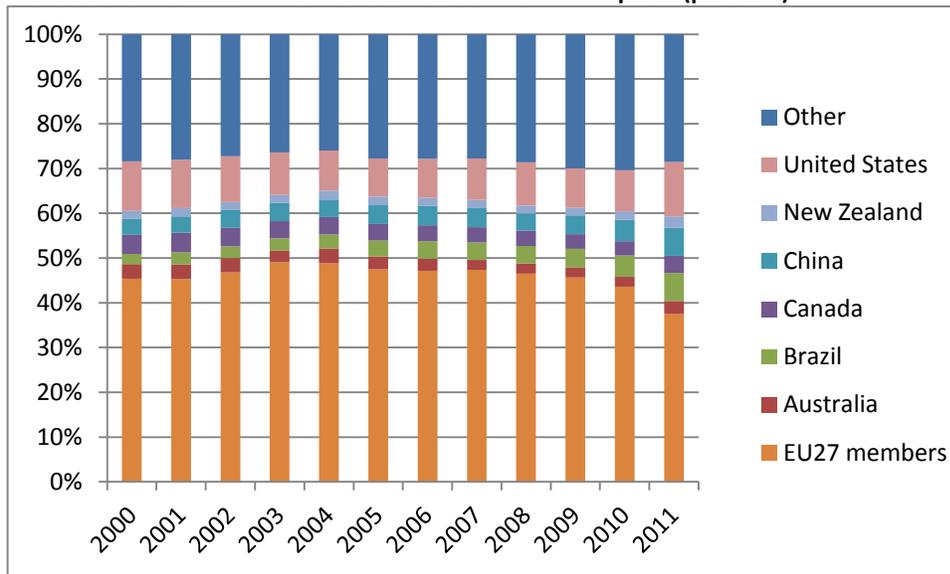
The competitive context is another factor that can drive and shape innovation. Given Alberta’s heavy reliance on resource extraction, it is not surprising to see a desire among policy-makers for economic diversification including an emphasis on food. But is the competitive context prompting businesses themselves to engage in more food innovation? Are there opportunities for Alberta Innovates to use its funding and communication levers to support those efforts?

Global Competition

From a global perspective, the food sector faces increasing competition from emerging, low-cost producers in the developing world as well as from higher-value producers in the developed world. Productivity improvements and falling trade barriers are creating much more competition. In recent years Canada has lost global export market share in key commodities and processed foods and beverages. For example, while Brazil increased its global export market share of processed foods from 2.3 to 6.3 per cent between 2000 and 2011 and China grew its share from 3.6 to 6.3 per cent, Canada’s share slipped from 4.2 per cent in 2000 to 3.2 per cent in 2010, before recovering somewhat 3.9 per cent in 2011.²⁷ Although some other developed countries also lost market share, others—such as New Zealand—managed to grow. (See Chart 6, “Shares of Various Countries in Global Food and Drink Exports”).

²⁷ Conference Board, *Competing for the Bronze*, 6; Conference Board, *Valuing Food*, 11.

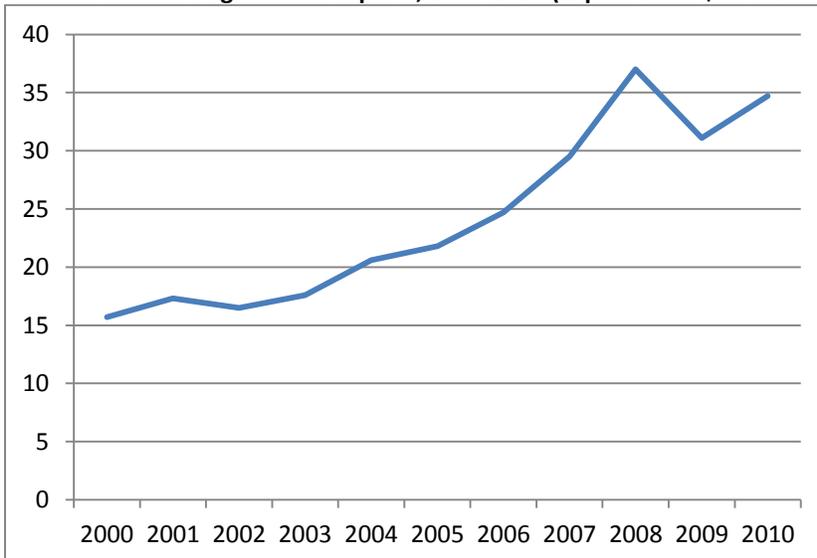
Chart 6
Shares of Various Countries in Global Food and Drink Exports (per cent)



Source: World Integrated Trade Solution.

Although Canada’s *share* of global food and drink exports slipped over this period, the absolute value of exports has actually increased. The issue, then, is not that Canada is exporting less, but that its export growth isn’t keeping pace with that of emerging economies. (See Chart 7, “Value of Canada’s agriculture exports, 2000-2010”)

Chart 7
Value of Canada’s agriculture exports, 2000-2010 (Export value \$US billions)

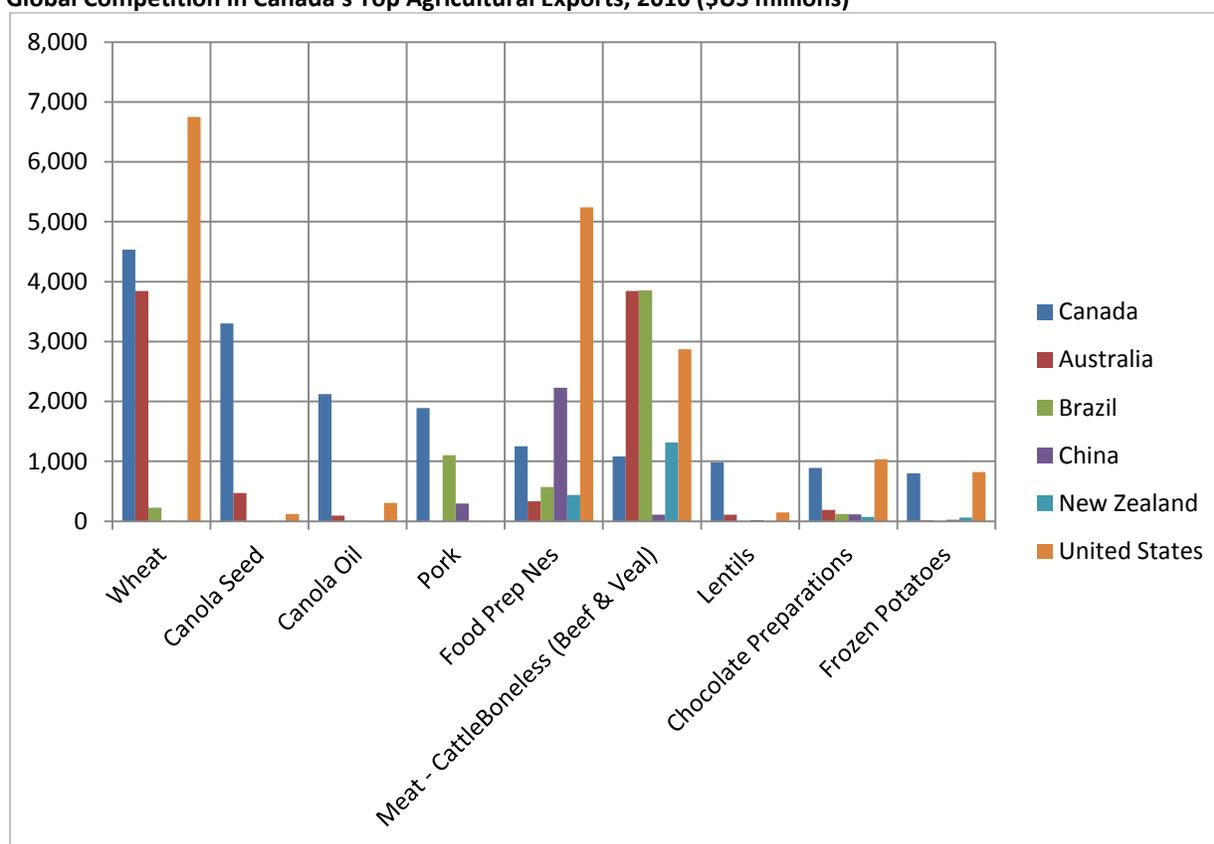


Source: FAO.

Moreover, while Canada is losing market share in some commodities, the country is holding its ground, or taking a larger share, in others. But even where Canada is a world leader, it faces stiff

competition from agricultural powerhouses. (See Chart 8, “Global Competition in Canada’s Top Agricultural Exports, 2010”). Although Canada faces little competition from the five agricultural powerhouses in the canola market, in almost every other commodity market in which Canada has a sizable share, at least one of the other five countries holds a larger share. For example, while Canada exported \$4.5 billion in wheat in 2010, the United States exported \$6.8 billion, and Australia a close \$3.8 billion. Although it does not appear in the chart, Canada exported \$1.4 billion in soybeans in 2010 but this was dwarfed by Brazil’s \$11 billion and the United States’ \$18.5 billion. And while Canada continues to play a large role in global markets for cooking fats and oils (labelled “food prep nes” in the table below) and boneless beef and veal, they lead in neither and nearly all of the other five agricultural leaders have substantial activity in those categories.

Chart 8
Global Competition in Canada’s Top Agricultural Exports, 2010 (\$US millions)²⁸



Source: FAO Stat.

To be sure, Canadian and Albertan producers have some room to reduce input costs to compete more effectively with developing world producers. But there are many costs—such as labour—on which Canadian and Albertan food businesses simply cannot compete. The upshot is that for the sector to sustain and improve its global competitiveness it will have to focus on higher-value

²⁸ “Food Prep Nes” refers to cooking fats prepared from both vegetable and animal oils and fats, usually containing 100 per cent fat. “Chocolate Prsnes” includes sweetened cocoa powder, chocolate and other food preparations containing cocoa, as well as sugar confectionery containing cocoa in any amount, but excludes white chocolate.

products which draw on the unique competitive strengths of the country and province. These will be products and processes that incorporate leading technologies to maintain superior quality, food safety, and nutritional value.

Rising Input Costs

Another food innovation driver for Alberta is the fact of rising input costs. Just as global competitors are emerging with a competitive advantage in terms of lower costs, Albertan and other Canadian food businesses are discovering that their own costs are actually increasing. Both primary inputs—such as dairy ingredients, potatoes, and starch—and energy costs are rising for processors. According to a 2006 survey, 37 per cent of Canadian processors reported that rising input costs were having a “moderate or major impact” on their competitiveness.²⁹

This trend is leading some food businesses to focus their innovation efforts on lowering costs and finding alternatives. Results from the Conference Board’s Food Industry Survey reveal that:

- 58 per cent of all Canadian food processors and retailers regard reducing costs as a very or extremely important determinant of their future success and 49.5 per cent feel that taking action is very or extremely important.
- Among Alberta-based processors and retailers, 69 per cent regard reducing costs as a very or extremely important determinant of future success and 44 per cent feel that taking action is very or extremely important.³⁰

Although the interest in taking action is important, the fact is that efforts to lower input costs, use them more efficiently, and/or find alternatives will face certain limits. And it is unlikely that Alberta food businesses will be able to lower costs in line with those of developing world producers. Fortunately, many food businesses recognize that they must focus not simply on reducing costs and trying to compete on price, but perhaps more importantly on process and product innovation to create higher value products for which consumers may pay a premium.

Food Safety as a Competitive Attribute

There is a general consensus in Canada that food businesses should not compete on the basis of food safety. Rather, firms should ensure that food is as safe as can be and fully comply with regulatory standards. Some stakeholders refer to this as a “pre-competitive aspect of the market” and worry that breaking the consensus could lead to competition between firms and provinces that no one wants to see.

Nevertheless, the reality is that consumers are concerned about differences in food safety performance across countries, as well as across firms. From an international perspective, there may be benefits to signalling that Albertan firms’ food safety measures and performance are stellar. Enhancing and emphasizing Canada’s and Alberta’s reputations for safe food can produce benefits. In fact, 56 per cent of Alberta food processors and retailers surveyed by the

²⁹ AAFC, *The Nature and Extent of Innovation in the Canadian Food Processing Industry*, 26.

³⁰ Conference Board, *Centre for Food in Canada: Industry Survey*.

Conference Board reported that improving food safety is a very or extremely important factor for their future success.³¹

Yet, there are also challenges in this area. In the first place, to maintain or enhance food safety firms need to innovate and invest in leading edge technologies, as well as more sophisticated management approaches to food safety processes and protocols. Moreover, although efforts to differentiate may be the original motive, there is a strong possibility that the challenge will simply be to keep up with competitors. In all cases, however, the bottom line is that there are both competitive pressures and opportunities driving firms to focus on food safety innovation. Thus, this will likely be a key area in which research and innovation investments by Alberta Innovates may produce both commercial and social benefits.

III. Regulatory Environment

Regulation not only has the ability to constrain innovation—for example, by prohibiting the use of certain ingredients or processes—but can also drive innovation by prompting firms to incrementally change their products and processes to meet regulatory requirements. To be sure, regulation does not have the same impact as market drivers, but regulators have tools to prompt or nudge innovation in certain directions. (See “Regulatory Strategies to Nudge Food Innovation”). The health claims process has been especially prominent in discussions about the impact of regulation on the nature and extent of food innovation.³²

Regulatory Strategies to Nudge Food Innovation

In the report, *Competing for the Bronze: Innovation Performance in the Canadian Food Industry*, the Conference Board distinguishes between four kinds of strategies that regulators can and have used in order to drive or shape food innovation in certain directions.

- **Prohibition and limitation.** Prohibiting or imposing limits on the use of various products, ingredients, or methods spurs firms to innovate in healthier or more environmentally responsible ways. For example, when British Columbia restricted the use of trans fats in restaurant food, firms had to find alternatives (for example, new ingredients and methods) to meet the requirement while also maintaining the taste and quality preferences of their customers.³³
- **Product claims assessment.** Regulatory requirements and processes related to claims about health, production methods, and quality can steer firms’ innovation efforts. A firm that wants to make a “low sodium” or “reduces risk of heart disease” claim on its packages, for example, must formulate its products in ways that meet the requirements while maintaining appeal to consumers. Requirements of the Canada Organic Regime—which govern the marketing of organic foods through a public-private co-regulatory partnership—can have the same effect on innovation in production methods.
- **Disclosure.** Regulation that requires companies to disclose the ingredients or methods they use can prompt firms to change those ingredients and methods. For example, when the federal government began requiring Nutrition Facts tables on processed food packages in December 2007,³⁴ consumers were better able to act on their preferences for healthier foods. This, in turn, heightened firms’ attention to how healthy or unhealthy their

³¹ Conference Board, *Centre for Food in Canada: Industry Survey*.

³² In addition to the discussion about the health claims assessment process later in this report, previous Conference Board work on food has assessed its impact. See Conference Board, *Competing for the Bronze*, 47-8; Conference Board, *Governing Food*.

³³ Conference Board, *Improving Health Outcomes*, 37.

³⁴ Health Canada, *Nutrition Labelling*.

products were perceived to be. Some firms responded by adopting “creative labelling practices” whereby they simply changed the reported serving size of their products so that levels of sodium, sugar, or harmful fats appear lower than they may actually be.³⁵ For others, however, a combination of consumer awareness and mandatory disclosure prompted sincere efforts to improve the nutritional content of products.

- **Signaling regulatory intentions.** Governments drive food innovation by sending signals about their regulatory priorities and intentions. These signals can be clear statements about imminent changes or simply more mention of specific areas of concern. When firms believe that the government is preparing regulatory changes, they often take pre-emptive action. For example, when the federal government urged processors and manufacturers to reduce trans fats voluntarily—and noted that it would bring in mandatory measures within two years if progress was weak—many processors and manufacturers voluntarily reformulated their products to reduce trans fats, even though they were not yet formally required, by regulation, to do so.³⁶

Source: The Conference Board of Canada.

In addition to the strategies described in the textbox, governments have the capacity to shape food innovation by offering incentives in the form of tax credits or resources (e.g., funding, research, expertise) to firms who pursue research and/or release products that align with government priorities. It is not clear, however, whether such incentives prompt firms to do different things or whether they simply reward or provide assistance to firms who already intend to work in the targeted areas.³⁷

IV. Science and Technology

So far we have considered demand-side drivers of food innovation. Consumer preferences, the competitive context, and the regulatory environment are changing and generating new ‘demands’ that food businesses must meet if they are to remain competitive. But opportunities also emerge from developments in food science and technology. Indeed, basic research findings often benefit food businesses and consumers even though neither foresee nor demand these things in advance. Specific developments in food science and technology will be explored in the next chapter, but it is useful at this stage to outline in general how food science and technology relate to food innovation.

Overall, Canadian science and technology is “healthy and growing in both output and impact” according to a recent assessment from the Council of Canadian Academies’ Expert Panel on the State of Science and Technology in Canada.³⁸ The panel notes that “with less than 0.5 per cent of the world’s population, Canada produces 4.1 per cent of the world’s scientific papers and nearly 5 per cent of the world’s most frequently cited papers” which places the country in sixth place in the world in terms of citation frequency.³⁹ Alberta performs well in this regard ranking second among provinces with respect to publications per faculty (2005-2010) and fourth on the Average

³⁵ B. Cook, “Advertising to Children in Canada.”

³⁶ For a discussion on Health Canada’s 2007 announcement on trans fats and its subsequent impact, see Conference Board, *Improving Health Outcomes*, 36-7.

³⁷ The impact of regulation on food innovation, including the health claims process, and Alberta-based businesses’ perspectives on the challenges are explored in greater depth in Chapter 3, “Alberta’s Research and Commercial Capacity for Food Innovation.”

³⁸ Expert Panel on the State of Science and Technology in Canada, *The State of Science and Technology in Canada*, 2012, xii.

³⁹ Expert Panel on the State of Science and Technology in Canada, *The State of S&T in Canada*, xii.

Relative Citations indicator⁴⁰—“a measure of the impact of research based on how many times it has been referenced relative to other research in that field.”⁴¹

Although food science and technology is not singled out as a key strength for Alberta, the Expert Panel does note that there is a rapidly growing research cluster in nanotechnology in Canada and that there is potential for the country to become a world leader in this area.⁴² This is an important observation given that one of the country’s major centres of nanotechnology—the National Institute for Nanotechnology—is based in Alberta and that nanotechnology research has important applications in food innovation, especially food safety and processing/packaging.⁴³ (The importance of nanotechnology research for food innovation in Alberta is examined in further depth in Chapter 4).

Some studies suggest that agricultural R&D investments can produce significant returns.⁴⁴ However, in most areas—especially emerging areas in food science and technology—it is difficult to measure the return on R&D investment. Only some—perhaps very few—developments in food science and technology will lead to commercial applications. In some cases this is simply a function of poorly selected investments from a commercialization perspective—i.e., investments in research where there is no foreseeable path to commercial application. In other cases, there may be commercialization potential, but weak alignment between the research and business communities undermines the commercialization process.

This pattern is characteristic not only of food science in Canada, but of science more generally. The Conference Board’s report cards on education and innovation consistently show that Canada excels in producing “science that is well respected around the world”, but “with some exceptions, Canada does not take the steps that other countries take to ensure research can be successfully commercialized and used as a source of advantage for innovative companies seeking global market share.” As a result, “Canadian companies are...rarely at the leading edge of new technology and too often find themselves a generation or more behind the productivity growth achieved by global industry leaders.”⁴⁵

This raises questions not only about *which* research investments would have a greater likelihood of being commercially applied, but also of *what steps* must be taken to improve that likelihood once investment decisions have been made. We address these questions later in the report. In any case, opportunities in basic research should form part of the analysis as successful investments have the potential to position Alberta food businesses at the leading edge of key areas of food innovation.

⁴⁰ Expert Panel on the State of Science and Technology in Canada, *The State of S&T in Canada*, 142.

⁴¹ Expert Panel on the State of Science and Technology in Canada, *The State of S&T in Canada*, 17.

⁴² Expert Panel on the State of Science and Technology in Canada, *The State of S&T in Canada*, 195.

⁴³ On the emerging importance of and Alberta’s research strengths in nanotechnologies, see Alberta Innovates Technology Futures, *Creating Opportunity: Alberta’s Nanotechnology Asset Map 2009*; and Expert Panel on Nanotechnology, *Small is Different*.

⁴⁴ S. Thompson, *Program Spending Returns – A Policy Brief*.

⁴⁵ Conference Board, *How Canada Performs: Innovation*.

From Trends to the Capacity to Respond

As this chapter reveals, trends and changes in consumer demand, the competitive context, the regulatory environment, and science and technology drive and shape food innovation. But specific opportunities and challenges depend on how researchers and businesses perceive and respond to trends. How are consumer concerns about health, safety, convenience, and other preferences translating into R&D and tangible products? What specific technological developments are emerging and being applied to improve food safety, processing, and packaging? Which opportunities are businesses pursuing?

The next chapter provides an account of Alberta’s commercial and research capacity to engage in food innovation, and considers two general challenges. With this foundation in place, the report then turns to the tasks of describing and analyzing specific food innovation opportunities for Alberta, with a focus on innovations in healthy food; food safety; platform, food processing, and packaging technologies; and food ingredients, food products, beverages, and supplements.

Chapter 3

Alberta’s Research and Commercial Capacity for Food Innovation

Chapter Summary

- Alberta has a moderate sized food sector by Canadian standards, though it does hit above its weight in some areas where it provides a decent receptor for research and innovation.
- Results from the Conference Board’s food industry survey reveal that Alberta food businesses are among the least motivated in Canada to pursue product, process, or input innovation, but show greater interest in food safety innovation.
- In general, Alberta has a strong research community which produces research that is well-respected globally, but food research is less prominent and links between food researchers and businesses are weaker than they could be.
- Challenges related to the regulatory environment, consumer receptivity, and the determinants of dietary patterns may limit the economic and health impacts that could be achieved by food research and innovation in Alberta.

There are many trends and opportunities in food innovation that researchers and businesses could pursue, but success will depend on whether there is capacity to succeed. As work on innovation in other sectors reveals, businesses that select opportunities that align with their existing capacity are more likely to succeed than those who pursue opportunities that are beyond their experience and expertise.⁴⁶ Similarly, research breakthroughs occur not when one deviates considerably from one’s field and expertise, but when something novel or unexpected emerges in that space.

This implies that the opportunities Alberta’s food sector can pursue successfully will depend on the existing capacity of its researchers and businesses. Although new initiatives have a chance of success even in the absence of rich capacity, investments are more likely to produce a return when they align with current capacity and build on existing competitive advantages. What, then, is the commercial and research capacity of Alberta’s food sector? This chapter details Alberta’s capacity and discusses challenges to achieving economic and social objectives through food innovation.

Commercial Capacity in Alberta’s Food Sector

In 2010, McKinsey & Company completed an assessment of significant economic growth areas on behalf of the Government of Alberta and identified key areas that have potential to become leading industrial sectors in the province. The list of growth sectors included refined petroleum products and petrochemicals; architecture, engineering and construction; metal fabrication; environmental products and services; financial services; aerospace; forest products; and building products.⁴⁷

Notably absent from the list is the food sector. As one interviewee remarked, “I would love for Alberta to be a centre for food product innovation. But there are certain realities. The population

⁴⁶ A.J. De Koning and D.F. Muzyka, “The Convergence of Good Ideas,” 6-7; Conference Board, *Managing Innovation*.

⁴⁷ Government of Alberta, *Alberta Industrial Sector Market Opportunities Report*.

base is small and the manufacturing infrastructure is not really there.”⁴⁸ This does not mean that Alberta’s food sector does not have growth opportunities—our analysis in this and later chapters reveals that some areas of the food sector are growing. It does mean that as the food sector innovates and grows it will have to choose its areas of focus carefully and it will likely have to compete for resources with other dynamic sectors. Indeed, people and capital were identified as key constraints on innovation and growth by many interviewees.

Size and Composition

Alberta has a moderate sized food sector by Canadian standards, though it does hit above its weight in certain areas. In 2011, total market receipts in crop and livestock production amounted to \$9.8 billion (or \$10.5 billion if program payments are included), and total sales in food and beverage manufacturing that year reached \$12.2 billion. Together, these industries contributed 4.1 per cent to Alberta’s GDP. Agriculture accounts for 2.93 per cent—nearly twice the Canada-wide total of 1.6 per cent—and food and beverage manufacturing contribute 1.17 per cent—a bit lower than the Canadian proportion of 1.7 per cent.⁴⁹

In terms of export sales, Alberta’s food sector is characterized by exports of both primary agricultural products and of higher value food and beverage products which means that there is already some diversification within the sector. In each case, however, Alberta’s export performance is overshadowed by that of other leading provinces—Saskatchewan, in the case of primary agriculture, and Ontario and Quebec, in the case of food and beverage exports. (See Chart 9 “Agricultural, food, and beverage exports of leading provinces”). Thus, although Alberta has a good balance, it may not be a prime investment market for either when compared with other Canadian provinces. Moreover, as data for Alberta presented above (p. 11) shows, exports of primary commodities is growing much faster (approximately 10 per cent annually over the past 4 years) than exports of higher value products (about 4 per cent annually). This means that the province’s food sector is becoming proportionally more, rather than less, dominated by lower value primary production and exports.

Looking at just food and beverage manufacturing—where much of the potential for high value-added innovation resides—we see that Alberta has a fair sized subsector with total sales of over \$12 billion and exports of \$3.4 billion. Moreover, food manufacturing sales make up 15.5 per cent of total manufacturing sales in Alberta, which is only slightly lower than in B.C (16.4 per cent) and a bit higher than the proportions in Quebec (13.8 per cent) and Ontario (12.2 per cent).⁵⁰ This implies that there may be a strong base from which to build and that there may be room to grow.

However, the food manufacturing subsector in Alberta is dominated by meat processing (47 per cent) and grain and oil milling (14 per cent)—activities that are not especially high up the value chain. (See Chart 10 “Food and Beverage Manufacturing Activities in Alberta”). Moreover, heavy concentration in only a few areas combined with few companies overall—774 in 2010—does not constitute a promising receptor community for research-driven insights. This is especially true of research not related in one way or another to meat processing. Still, there may

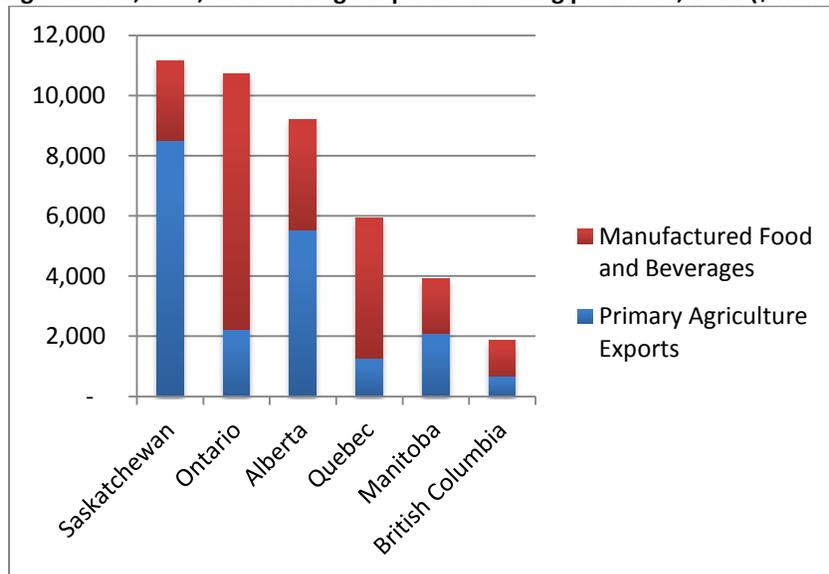
⁴⁸ Confidential interview with industry association director. Interview by James Stuckey. February 2013.

⁴⁹ Alberta Agriculture and Rural Development, *Agriculture Statistics Factsheet*.

⁵⁰ Statistics Canada, *Manufacturing sales, by North American Industry Classification System (NAICS) and province*.

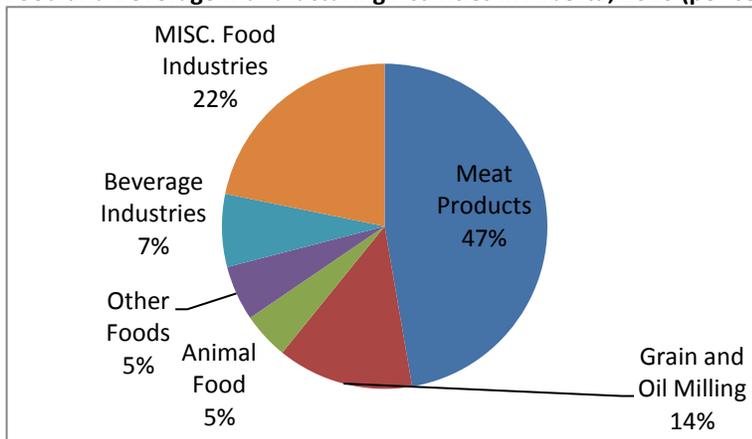
be research investments that can be made to support innovation in core areas and, moreover, there may be large enough pockets of higher-value activities that could be ripe for growth with the rights kinds and amounts of support. We explore these possibilities in later chapters.

Chart 9
Agricultural, food, and beverage exports of leading provinces, 2012 (\$ millions)



Source: Statistics Canada; World Trade Atlas.

Chart 10
Food and Beverage Manufacturing Activities in Alberta, 2010 (per cent)



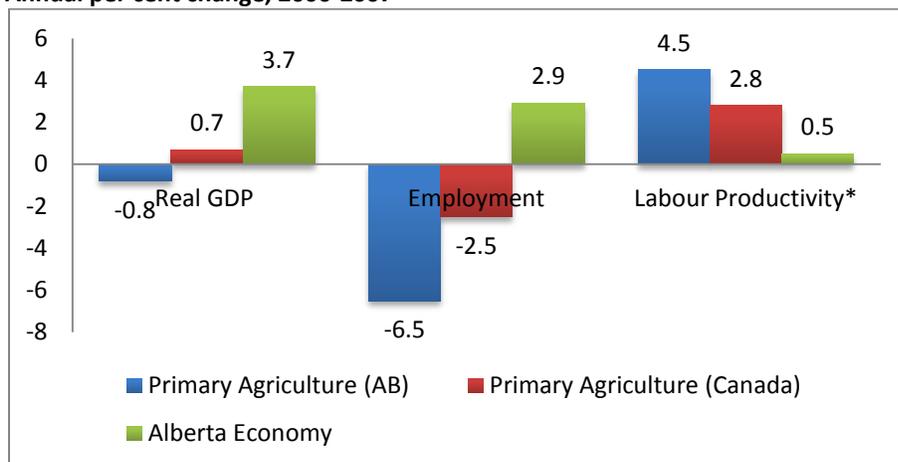
Source: Statistics Canada.

Performance

Another key consideration with respect to the sector’s innovation capacity relates to performance and growth potential. In the years leading up to the recession, the performance of the primary agriculture sector in the province was quite weak. Between 2000 and 2007, the sector experienced an average annual loss of 0.8 per cent while agricultural across Canada more

generally grew by 0.7 per cent and the Alberta economy as a whole grew by 3.7 per cent.⁵¹ Interestingly, however, the labour productivity of the Alberta agricultural sector outpaced both that of Canadian agriculture and the Alberta economy as a whole. (See Chart 11, “Performance of the Primary Agriculture Sector”).

Chart 11
Performance of the Primary Agriculture Sector
Annual per cent change, 2000-2007



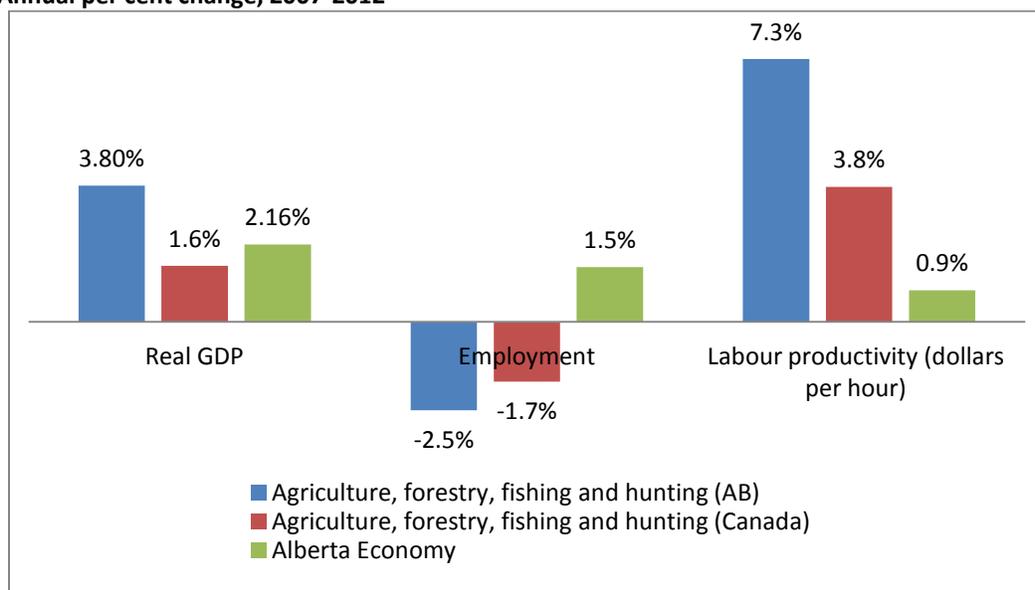
Source: PWC (*Real GDP Per Hour Worked)

More recent data does not separate agriculture out from the larger agriculture, forestry, fishing, and hunting category, so a clear picture is hard to obtain. Nevertheless, within that larger category, the patterns with respect to employment and labor productivity are about the same, albeit magnified, while the real GDP situation is more positive. However, it is not clear whether this is due to the performance of agriculture or forestry. (See Chart 12, “Performance of the Agriculture, Forestry, Fishing, and Hunting Sectors.”)

The situation with respect to the broader agri-food sector, including manufacturers, is somewhat different, but still problematic. (See Chart 13, “Performance of the Agri-food Sector”). The Alberta agri-food sector posted average annual growth of 0.4 per cent while agri-food in all of Canada doubled that performance with growth of 0.8 per cent. And unlike the impressive labour productivity of Alberta’s primary agricultural sector, the province’s agri-food sector witnessed average annual productivity gains of only 0.3 per cent compared to 3.2 per cent for Canadian agri-food as a whole. The performance of these sectors during this time frame is rather troubling—it suggests an industry that was stagnating even before the recession and which may have trouble attracting the resources—financial and human—that would be necessary for innovation and growth.

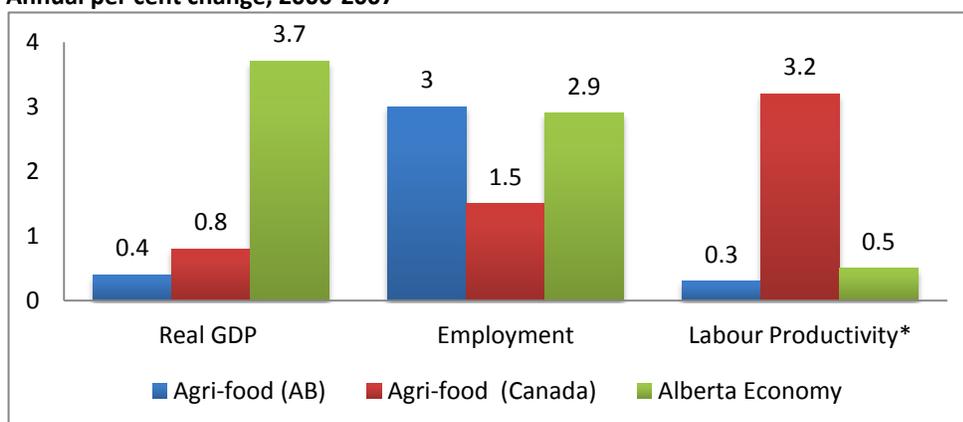
⁵¹ More recent Statistics Canada data on jobs do not adequately distinguish food and food manufacturing from the broader categories of “agriculture, forestry, fishing and hunting” and “manufacturing.” Thus, the data presented here are the most up to date data for the narrower categories of interest.

Chart 12
Performance of the Agriculture, Forestry, Fishing, and Hunting Sectors
Annual per cent change, 2007-2012



Source: Statistics Canada, Table 383-0029.

Chart 13
Performance of the Agri-food Sector
Annual per cent change, 2000-2007



Source: PWC (*Real GDP Per Hour Worked)

Investment in the Food Sector

Alberta is an attractive province for investment. A 2010 survey of money managers by the Fraser Institute ranked Alberta first among all provinces in terms of investment climate, based on top rankings in the key sub-categories of corporate income tax, fiscal prudence, personal income tax, labour market regulation, and burden of regulation.⁵² Yet, despite the strong climate in general, Alberta has experienced relatively low levels of investment in its agri-food businesses.

⁵² C. Lammam, Gainer, and Veldhuis, *Canadian Provincial Investment Climate*.

Although 14 of Canada’s top 25 food and beverage processors have a plant presence in Alberta, few seem to locate much R&D activity in the province.⁵³ While the crop production subsector shows moderate growth in investment in fixed assets, other subsectors show declines in this area. And investment in intellectual property products across Alberta’s food industry is very weak.⁵⁴

- **Crop production.** Investment in total fixed assets in Alberta crop production reached \$671 million in 2012, representing average annual growth of 4.4 per cent over the past 12 years and constituting 21 per cent of all fixed asset investment in Canadian crop production. By contrast, investment in intellectual property products in Alberta crop production amounted to a mere \$1.9 million in 2012 representing an average annual *decline* of 0.4 per cent and constituting only 4 per cent of all investment in IP products in Canadian crop production.⁵⁵
- **Animal production.** Investment in total fixed assets in Alberta animal production amounted to \$297.4 million in 2012, representing an average annual *decline* of 3.1 per cent over the past 12 years but still constituting a healthy 18.6 per cent of all fixed asset investment in Canadian animal production. Investment in IP products in Alberta animal production amounted to only \$2.1 million in 2012, representing an average annual *decline* of 4.9 per cent and constituting only 4.7 per cent of all investment in IP products in Canadian animal production.⁵⁶
- **Food manufacturing.** Investment in total fixed assets in Alberta food manufacturing totalled \$104.8 million in 2009 (the most recent year for which data are available), representing an average annual decline of 4.6 per cent over the past 9 years and constituting less than 6 per cent of all fixed asset investment in Canadian food manufacturing. Investment in IP products in Alberta food manufacturing amounted to \$7.7 million in 2009, representing an average annual *decline* of 3.8 per cent and constituting only 3.1 per cent of all investment in IP products in Canadian food manufacturing.⁵⁷

Many possible explanations exist for low and declining investment in Alberta’s food sector. Labour shortages are an issue. At 4.8 per cent, Alberta’s unemployment rate is the second lowest in the country and well below the national rate of 7.2 per cent.⁵⁸ In 2012, occupations unique to agriculture in Alberta had unemployment of only 1.8 per cent, indicating an exceptionally tight labour market.⁵⁹ Not surprisingly, labour costs in Alberta increased by an average of 6.6 per cent in the 8 years leading up to the recession (2000-2007) versus just 3.6 per cent nationally. In fact, wage growth in Alberta’s agriculture/forestry and manufacturing sectors was 7.6 and 7.7 per cent, respectively.⁶⁰ If companies are struggling to staff current operations, they may be hesitant to invest in and/or expand operations in Alberta, especially given prevailing wage rates. Other provinces may simply appear more attractive for investment.

⁵³ Alberta Agriculture and Rural Development, *Alberta’s Agricultural Processing Industry Directory*.

⁵⁴ Formal intellectual property protection plays a less prominent role in food innovation than innovation in other sectors. Firms will often rely on secrecy about recipes and processes rather than patenting products, ingredients, or processes. Thus, lower IP investment is to be expected. Nevertheless, the performance of Alberta’s food industry in this regard is especially weak.

⁵⁵ Statistics Canada, *Flows and stocks of fixed non-residential capital* (Table 031-0002).

⁵⁶ Statistics Canada, *Flows and stocks of fixed non-residential capital* (Table 031-0002).

⁵⁷ Statistics Canada, *Flows and stocks of fixed non-residential capital* (Table 031-0002).

⁵⁸ Statistics Canada, *Labour force characteristics, seasonally adjusted, by province*.

⁵⁹ Government of Alberta, *Alberta Unemployment Rate by Occupational Group*.

⁶⁰ Price Waterhouse Coopers, *Alberta Industry Sector Performance and Prospects*, 72.

The relative size of Alberta’s food manufacturing sector may also be a deterrent to investors. In 2010 Alberta was home to 774 food manufacturing companies who earned revenues over \$10 billion. By contrast, Ontario had 2,480 firms and revenues over \$34 billion, and Quebec had 1,839 firms and \$20 billion in revenues in food manufacturing.⁶¹ Still, Alberta food manufacturers are very efficient with revenues per establishment at \$13.5 million—second only to Ontario at \$13.8 million. And Alberta food manufacturing firms achieved this with a lower employee-per-establishment ratio—26.2 employees per firm versus 33.5 in Ontario, 30 in Quebec, and 29.3 nationally. B.C. had the lowest ratio at 21.8 employees per food manufacturing firm.⁶² Yet, although Alberta firms are running more efficiently, there is simply more activity in the food manufacturing sectors in Ontario and Quebec which creates clusters of expertise to drive further collaboration and growth.

Business Motivation to Innovate

An important barrier to food innovation performance in Canada is a strikingly low level of motivation to pursue innovation among Canadian food businesses.⁶³ The Conference Board’s Centre for Food In Canada food industry survey revealed that only a quarter to a third of businesses felt that product, process, or input innovation was very or extremely important to future business success. The survey showed even lower motivation among Alberta-based businesses. (See Chart 14, “Importance of Innovation for Business Success, by Province”).

Alberta food businesses’ motivation to innovate is in many cases much lower than motivation in B.C. and Quebec. Quebec-based firms, for example, are 11 per cent more likely to regard product innovation, and 14 per cent more likely to regard input innovation, as very or extremely important to future success. The situation improves slightly when one looks only at the responses from the food manufacturing and retailing subsectors which tend to be closer to the consumer and engage in higher value innovation than the primary agriculture subsectors. But even there, Alberta-based businesses reveal lower interest and motivation to innovate.

Although the reasons for lower motivation are not entirely clear, Alberta animal producers appear to be the least interested in innovation among all Albertan and Canadian food businesses.

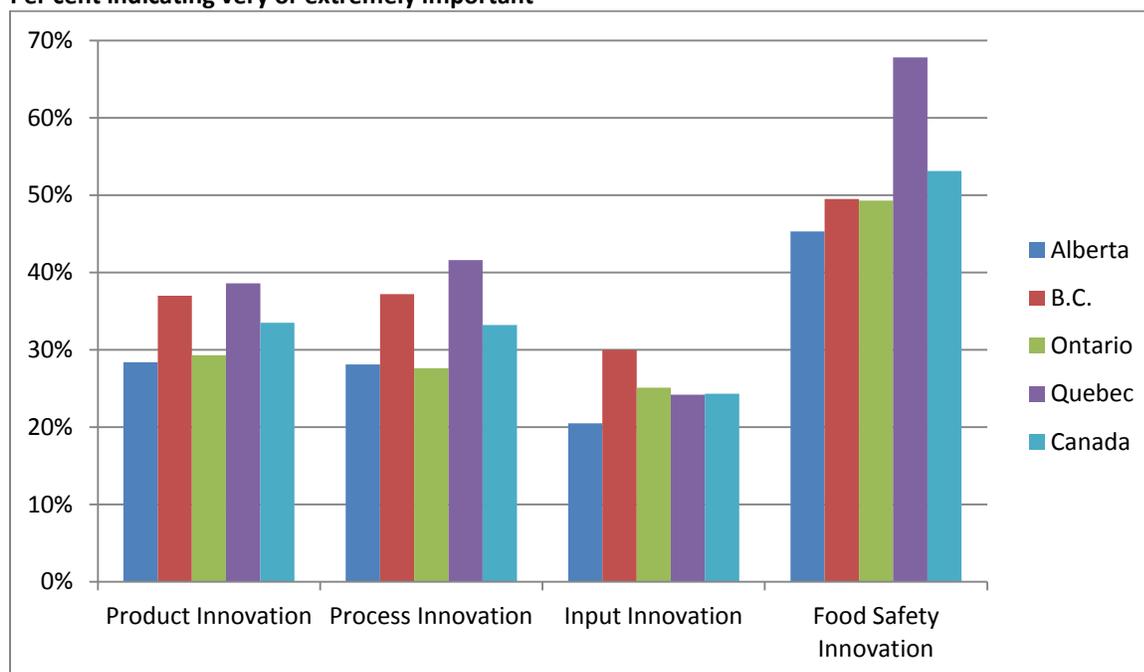
- In terms of product innovation, the average score (on a scale from 0 to 4) for all Canadian food businesses (excluding Alberta) was 1.98; 1.79 for all Albertan business; and 1.95 for all Canadian animal producers (excluding Alberta). By contrast the average score for Alberta animal producers was 1.29.
- On process innovation, the average score for all Canadian food businesses (excluding Alberta) was 2.05; 2.02 for all Alberta food businesses; and 2.09 for all non-Albertan Canadian animal producers. Albertan animal producers produced an average score of 1.81.
- Finally, on input innovation, the average non-Albertan Canadian food business score was 1.72; 1.62 for Alberta food businesses; and 1.73 for non-Albertan animal producers. Albertan animal producers produced an average score of only 1.44.

⁶¹ Statistics Canada, *Principal statistics for manufacturing industries, by North American Industry Classification*.

⁶² Statistics Canada, *Principal statistics for manufacturing industries, by North American Industry Classification*.

⁶³ Conference Board, *Competing for the Bronze*, 19.

Chart 14
Importance of Innovation for Business Success, by Province, 2011
 Per cent indicating very or extremely important



Source: The Conference Board of Canada.

Low interest in innovation may complicate government decision-making regarding investments in food research and innovation. If only a quarter of Alberta food businesses are interested in product, process, or input innovation, the potential for commercialization of research results will also be low. In this case, maximizing commercial uptake and impact of research investments might best be achieved by supporting innovation activities and programs that identifiable businesses are already interested in pursuing. At the same time, it appears that there is significant potential for interest in research in food safety in the province. Although Alberta businesses are less interested in food safety innovation than firms in other provinces, nearly half (45 per cent) indicate that it is very or extremely important.

Research Capacity in Alberta

If one were to look only at government and research organizations and activities, one would get the impression of a province deeply committed to research and innovation. In addition to the various organizations that together compose the impressive Alberta Innovates, the province has major research universities and colleges, spends considerable resources on research and innovation, and prides itself on an innovative, can-do culture. As the following analysis reveals, there is good reason to believe that Alberta has a strong research capacity for innovation in general. The question is whether this research capacity is well-aligned with the capacity, interests, and activities of Alberta-based food businesses.

Research Infrastructure

For a province with fewer than 4 million residents, Alberta boasts a strong research community which extends to food research and innovation. In terms of academic infrastructure, research capacity at the University of Alberta and the University of Calgary is healthy and researchers at those institutions are successful in attracting resources from both the provincial and federal governments. Additionally, the province is home to a number of colleges, polytechnics, and intermediary institutions that help link research with business needs. Although the precise size and configuration of the institutions and infrastructure described in the Alberta Life Sciences Institute’s *Food For Health Asset Map* may have changed, the basic institutional arrangements remain much the same.⁶⁴ Thus, rather than repeating what is in that document with minor modifications, this section simply points to a few highlights relevant to the current project.

- *Food Processing Development Centre (Leduc)*. The Centre has become an important part of the food innovation ecosystem in the province, though opinion is mixed about whether it is achieving its potential and performing as effectively as it could. It has a fully equipped plant and product development laboratory which has helped many companies with their innovations, particularly in High Pressure Processing. The Centre has helped a number of companies on relatively small budgets to develop and commercialize innovations, and assist with business plans and networking. Some interviewees expressed concern, however, about the performance of the Centre in terms of connecting business clients with investors and contributing to significant scaling up of innovative activity.
- *National Institute for Nanotechnology (NINT)*. NINT has the potential to become a very important part of Alberta’s food innovation efforts. Based at the University of Alberta and jointly operated with the National Research Council, NINT not only conducts basic research in nanotechnology, but also collaborates with businesses on industry-relevant projects. In food innovation, nanotechnology is becoming increasingly important with developments in nanosensors, nanoencapsulation, and other areas, poised to make significant contributions.
- *University of Alberta’s Agricultural Genomics and Proteomics (AGP) Unit*. The AGP is “a centralized resource making available the sophisticated and complex equipment and technologies to multiple users to foster agricultural research.”⁶⁵ Faculty associated with the AGP conduct a range of food-related research and innovation projects, and the facility itself serves as a training and teaching ground for genomic and proteomic experiments. A number of the researchers associated with the unit were interviewed as part of this project, some of whom have conducted research that has led to a commercializable technology or product and/or a spin-off company. The concentration of expertise in the AGP Unit promises to be a continuing source of food research and innovation.
- *University of Alberta’s Agri-Food Discovery Place (AFDP)*. The AFDP is a university-owned processing facility partnered with Olds College and Alberta Agriculture & Rural Development. It conducts applied research in food safety, ag-industrial technologies, functional food and natural health products and assists with commercialization in these areas. The Meat Safety and Processing Research Unit housed in the AFDP is a “containment Level 2 meat processing facility” which allows for the “processing of meat with food borne

⁶⁴ S. Murgatroyd and S. Moran, *Food For Health: An Asset Map*.

⁶⁵ University of Alberta, *Agricultural Genomics and Proteomics Unit*.

pathogens throughout the processing chain including retail and consumer handling.”⁶⁶ As such, the MSPRU provides the meat and food processing industry facilities and capacity to conduct food safety and quality validation projects on new methods and technologies. The facility’s capacity and expertise in meat processing and safety is especially relevant to research and innovation opportunities that align with Alberta’s food sector strengths.⁶⁷

- *Agrivalue Processing Business Incubator (APBI)*. Operated as a not-for profit business by Alberta Agriculture and Rural Development, APBI provides space for new or expanding food processors to set up food processing operations, refine processing techniques and establish a market presence. Clients can share experiences and expertise with other entrepreneurs at APBI and take advantage of economies of scale by sharing services and facilities. APBI offers a variety of sizes of suites that can be set up to process a wide range of food products. The facility is federally registered, which allows clients to sell their products across Canada and internationally. Clients who lease space at the APBI also have access to a wide range of fee for business services, including: cost accounting, legal advice, marketing, quality control, and scientific and technological development.⁶⁸
- *The Metabolomics Innovation Centre (TMIC)*. Located at the University of Alberta, TMIC is a nationally funded facility that performs a wide range of metabolomics research, such as: clinical trials, biomedical studies, bioproducts studies, nutrient profiling, and environmental testing. Metabolomics looks at the chemical processes in living organisms involving metabolites—it has applicability to disease diagnostics; agriculture; food safety; and pharmaceutical research and development.⁶⁹ One research project at TMIC is analysing the chemical constituents of approximately 70 foods produced in Alberta. The project will examine micronutrients in different foods, as well as the compounds that give foods their taste and colour. Data from the project will be placed in a publically accessible database that will include fact sheets geared towards the general public. The aim of the database is to help Alberta consumers make more educated food buying decisions and enable Alberta producers to market the health benefits of their products.⁷⁰ In addition to its research activities, the TMIC offers custom metabolomics services for industry, such as analysis for “medical, agricultural, and food processing (including functional food and nutraceutical).”⁷¹ TMIC’s services are faster, more quantitative, and more comprehensive than any other North American facility.⁷²
- *The Alberta Innovates Phytola Centre*. The University of Alberta’s Phytola Centre focuses on the development of value-added oilseed products for nutritional and industrial markets. Key activities of the Centre include: increasing seed oil content in canola; development of oilseeds producing beneficial fatty acids (e.g. omega-3) for human and animal nutrition; and the development of bio-oils for non-food applications. The Centre actively pursues opportunities to work with industry.⁷³

⁶⁶ Agri-Food Discovery Place, *About Us*.

⁶⁷ Agri-Food Discovery Place, *About Us*.

⁶⁸ Alberta Agriculture and Rural Development, “Alberta Processing Business Incubator.”

⁶⁹ The Metabolomics Innovation Centre, “Metabolomics.”

⁷⁰ Crawshaw, “Alberta Innovates: Food for Thought.”

⁷¹ The Metabolomics Innovation Centre, “About.”

⁷² The Metabolomics Innovation Centre, “About.”

⁷³ University of Alberta, “Phytola and Bioactive Oils Program.”

- *Livestock Gentec*. Based at the University of Alberta, Livestock Gentec is an Alberta Innovates Biosolutions centre. The centre brings together a variety of stakeholders, including: universities, research networks, livestock industry associations, government agencies, and the private sector. Created in 2010, Livestock Gentec continues the research of the Alberta Bovine Genomics Program (AMGP) and aims to bring the commercial benefits of genomics to the Canadian livestock industry.⁷⁴ The centre aims to contribute to innovation in the livestock industry by: “creating a body of knowledge that will help improve livestock genetics; providing tools that industry can use to make genetic selection decisions sooner; and developing the skills and facilities to turn the technology into useable information.”⁷⁵ Livestock Gentec builds on existing technology transfer and industry collaboration activities.⁷⁶

These are only a few of the organizations that play important roles in Alberta-based food research and innovation and there are many more. The report examines other aspects of institutional capacity in the context of specific innovation opportunities in the following chapter.

R&D Spending and Employment

Spending on research and development (R&D) is a useful indicator of commitment to generating new ideas that could lead to new or improved products, processes, and services. Public and private R&D—on basic and applied research—contributes to a country’s overall innovation and productivity performance. Public R&D spending is particularly important because it is often focused on the basic research that underpins an innovative economy but that businesses are less inclined to conduct themselves because of its weaker links to firm-level performance. Moreover, public R&D spending—particularly higher-education R&D spending—is an essential way for a country to support training and development of the next generation of researchers who will contribute to innovation.⁷⁷

Food-Related Public R&D Spending in Alberta

Total public R&D spending in Alberta has been increasing over the past decade. Steady increases were the norm between 2006 and 2010 and, although there was a dip in 2010-11, public R&D spending for 2011-12 was projected to reach record levels. (See Chart 15, “Total Government R&D Expenditures in Alberta, 2006-2012”). Disaggregating the total reveals useful insight about the research priorities of the province. R&D spending related to human health constitutes approximately 23 per cent of the total, followed by research related to control and care of the environment (14.8 per cent), and energy (12.5 per cent). Research related to agricultural production and technology consumed 10 per cent of public R&D expenditures.⁷⁸ It is difficult to disentangle the precise amount spent on food-related research, but with sizable spending on human health and agriculture-related activities, food-related research likely achieves substantial support.

⁷⁴ Livestock Gentec “About Gentec.”

⁷⁵ Livestock Gentec, “Innovation.”

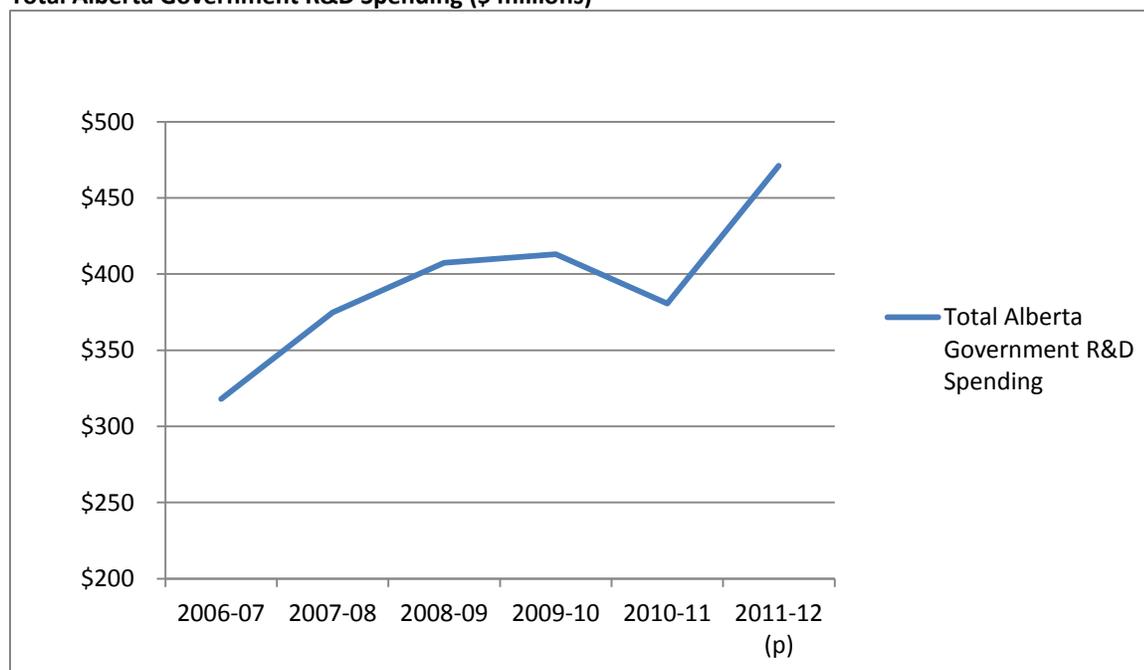
⁷⁶ Livestock Gentec “About Gentec.”

⁷⁷ This paragraph draws from Conference Board, *How Canada Performs: Innovation*.

⁷⁸ Alberta Enterprise and Advanced Education, *Scientific Activities of the Government of Alberta 2010-11*.

Chart 15

Total Alberta Government R&D Spending (\$ millions)



Source: Government of Alberta, *Scientific Activities of the Government of Alberta 2010-11*

Food-Related Business R&D Spending in Alberta

While public R&D spending on food-related research is relatively strong in Alberta, business R&D spending on food-related research by Alberta-based firms is quite weak. In 2010, agricultural firms in Alberta spent a mere \$4 million on R&D constituting less than 4 per cent of the total \$99 million spent nationally and well behind spending in Ontario (\$42 million) and Quebec (\$32 million). Alberta-based food manufacturers performed even worse with only \$3 million spent on R&D in 2010 making up less than 2 per cent of the \$165 million spent nationally and well behind not only Ontario (\$64 million) and Quebec (\$60 million), but also B.C. (\$12 million), Atlantic Canada (\$11 million), and Saskatchewan (\$5 million).⁷⁹

Not surprisingly, the total number of R&D full-time equivalent personnel employed by food manufacturing firms in Alberta was only 52 in 2010—down from a high of 97 in 2008. By contrast, Ontario food manufacturing firms employed 913 full-time researchers while Quebec employed 773, B.C. employed 174, and firms in the Atlantic provinces together employed 113.⁸⁰ In short, the Alberta food industry does not fare well in terms of R&D investment. In total R&D dollars spent, Alberta food manufacturing is second to last in Canada and it has the lowest investment as a percent of R&D expenditures in all industries (0.22 per cent).

⁷⁹ Statistics Canada, *Business enterprise research and development (BERD) characteristics, by industry group*.

⁸⁰ Statistics Canada, *Business enterprise research and development (BERD) characteristics, by industry group*.

Research Quality and Impact

Based on its research infrastructure and spending, Alberta performs very well overall in terms of research output and impact.⁸¹ As noted in the previous chapter, Alberta ranks second among all provinces with respect to publications per faculty (2005-2010) and fourth in research impact in the research community.⁸² This is a very strong result given that Canada as a whole hits above its weight producing 4.1 per cent of the world’s scientific papers and 5 per cent of the most frequently cited papers with less than 0.5 per cent of the world’s population.⁸³ Food science and technology is not singled out as a key strength for Alberta, but its activities in nanotechnology may be a source of competitive advantage for food innovation.⁸⁴

Research-Business Linkages

Alberta researchers are well-respected and achieve significant impact in the research community, but the connections between researchers and business in the food sector are weaker than they could be. With some exceptions—notably in the nutraceuticals field where interviewees revealed a small, but tight-knit community of researchers and businesses—food-related researchers and businesses in Alberta display poor communication and collaboration and this impairs food innovation performance overall. Interviews with researchers, businesses, and industry associations repeatedly revealed a concern that the activities of food researchers and food businesses are frequently misaligned and that connections between researchers and large multinational firms are very poor.

This feature was captured in one interviewee’s observation that “Alberta has reasonably good research capacity, but no good process for assisting in getting research commercialized and translated into products. Part of the problem is that the province’s innovation facilitators tend to spend most of their time on the dominant industries like oil and gas. Agri-food gets lost.”⁸⁵

Challenges

Even in those areas where there is clear alignment between food innovation opportunities and commercial and research capacity, there are still major challenges to success. Although challenges specific to candidate opportunities for Alberta Innovates Bio Solutions will be assessed in subsequent chapters, two general challenges are worth exploring at the outset—namely, regulation (particularly health claims) and consumer receptivity.

I. Regulation

Regulation is important in ensuring that the food industry produces safe food with minimal environmental impact and provides accurate information about its products in labels and

⁸¹ Expert Panel on the State of Science and Technology in Canada, *The State of S&T in Canada*, xii.

⁸² Expert Panel on the State of Science and Technology in Canada, *The State of S&T in Canada*, 142.

⁸³ Expert Panel on the State of Science and Technology in Canada, *The State of S&T in Canada*, xii.

⁸⁴ Expert Panel on the State of Science and Technology in Canada, *The State of S&T in Canada*, 195. On the emerging importance of and Alberta’s research strengths in nanotechnologies, see Alberta Innovates Technology Futures, *Creating Opportunity: Alberta’s Nanotechnology Asset Map 2009*; and Expert Panel on Nanotechnology, *Small is Different*.

⁸⁵ Interview with research expert by the Conference Board.

marketing. Yet, previous Conference Board research has shown that Canada’s system of policies, laws, and regulations can impede food innovation and commercialization—including healthy food innovation.⁸⁶ Restrictions related to permissible health and marketing claims, and slow product approval processes, have delayed or impeded innovations that could have both health and commercial benefits. Additionally, innovations that could improve food safety have been caught in regulatory review for years, even as peer countries have approved the same innovations and are seeing benefits.

The Conference Board’s Food Industry Survey shows that most food businesses regard the regulatory system as having an overall positive impact on their performance:

- 61 per cent of Canadian and 55 per cent of Alberta food businesses say that the overall impact of regulation on their performance is somewhat or very positive.
- 21 per cent of Canadian and 25 per cent of Alberta food businesses say that the overall impact of regulation on their performance is somewhat or very negative.

At the same time, 62 per cent of Canadian and 51 per cent of Alberta food businesses report that improved regulation is important to the realization of business opportunities. In short, the food industry regards regulation as beneficial, but imperfect.

Health Claims

The health claims process has become a particular point of contention for the food industry. Food companies’ success in capturing part of the consumer market for healthier food depends on the ability to communicate the health benefits of new products or ingredients to customers.⁸⁷ This is especially true when reformulation changes a product’s taste and businesses want to provide consumers with information about the health benefits they gain even at the loss of some taste.

Yet, many of the business and food researchers interviewed report that Health Canada’s process for verifying health claims can be a significant source of delay, lost opportunity, and competitive disadvantage. Food businesses that have gone through, or are currently going through, the health claims process observed that it can be a confusing and unpredictable process and that it is often difficult even to get information about the status of a submissions.

A private equity firm that invests in innovative food companies revealed that they do not invest in any food product until “it has *already* made it through any Health Canada/CFIA approval processes. It’s too risky to invest before that is complete.”⁸⁸ Another interviewee who works with many small companies on food innovation described the health claims process as “nebulous, complicating, and exhausting.”⁸⁹ Others expressed a similar mix of confusion and frustration. A number of interviewees also noted that their commercialization strategies focus on the U.S. rather than the Canadian market given a perception that regulatory requirements and processes in the U.S. are clearer and easier to navigate.

⁸⁶ Conference Board, *All Together Now*.

⁸⁷ Conference Board, *Competing for the Bronze*, 47.

⁸⁸ Confidential interview (private equity firm). Telephone interview by Erin Butler, December 2012.

⁸⁹ Confidential interview with association executive. Interview by James Stuckey. January 9, 2013.

Concern is particularly high with respect to the delays firms face in the pre-market approvals process. As recently as 2007, an audit revealed that nearly half (46 per cent) of all food additive, novel food, and infant formula submissions had been in the pre-market approval pipeline for a year or longer despite notification standards that require a much more prompt response time.⁹⁰ Delays such as these impair the innovation performance of food businesses not only by preventing more timely responses to market trends, but also by consuming time and money to navigate the process that could be spent elsewhere, such as on further research and innovation. The Conference Board’s previous research on food innovation also found that delays in reaping returns on firms’ research and innovation investments can negatively affect sustainability—especially that of small, start-up firms that often depend on the early success of a few key products.⁹¹

Regulatory Modernization

But there are signs that the regulatory environment for food innovation—including healthy food innovation—is improving. Recognizing that current approvals processes “can take many months and sometimes even years” and that “these delays limit access to innovative and safe products for Canadians,”⁹² two changes to the *Food and Drugs Act* were recently introduced:

- ***Marketing authorizations*** will give the health minister greater power to “make general rules permitting the sale of foods and the use of substances that are in—or on—foods” and to “permit the use of substantiated health claims.”⁹³ This constitutes an improvement over the current system under which the minister has authority only to *temporarily* approve some substances in certain situations, and in which permanent approvals require a change in regulation.⁹⁴ The scientific review process and level of scrutiny remains unchanged. This change is intended to streamline the post-scientific review process with maintaining rigorous health and safety oversight.
- ***Incorporation by reference***. The current system requires Health Canada to follow a time-consuming amendment process whenever it aims to incorporate new standards, methods, guidelines, or documents—including lists of approved food additives, vitamins, and minerals being added to foods, and health claims—into the *Food and Drug Regulations*. The new system permits “incorporation by reference” into the regulation in place of regulatory amendment. The new power can be exercised only *after* scientific assessments have been completed.⁹⁵

These changes may improve food innovation by streamlining the regulatory system, but it remains to be seen just how much the situation will improve. Additionally, the timelines and requirements related to the scientific assessment process may continue to produce challenges and

⁹⁰ Standards with respect to notifications range from 45 days to 225 days, depending on the product and the information required by Health Canada. See Health Canada, *Final Audit Report*, 6; and Department of Justice, *Food and Drug Regulations*, B.25.046 and B.28.003.

⁹¹ Conference Board, *Competing for the Bronze*, 48.

⁹² Health Canada, *Amendments to the Food and Drugs Act*.

⁹³ Health Canada, *Questions and Answers Regarding the Amendments to the Food and Drugs Act*.

⁹⁴ The change does not affect the level of scientific scrutiny required, as it entails only processes that occur after scientific assessment. As such, it promises to improve regulatory efficiency without reducing health and safety oversight.

⁹⁵ Health Canada, *Amendments to the Food and Drugs Act*.

delays for food businesses. To be sure, the assessments must be rigorous in order to protect the public, but there is persistent concern that the standards of evidence are too onerous and the process too slow.

II. Consumer Receptivity

Another challenge to food innovation is consumer receptivity. Not only does consumer receptivity affect the performance of new products and the food sector generally, it also determines the extent to which health outcomes can be improved through diets. Even when firms have completed rigorous market research, consumers may not respond favourably to specific products. There are two dimensions to consider—the determinants of consumer choices and dietary patterns (especially as they relate to healthy diets) and consumer receptivity to new and emerging technologies.

Determinants of Food Choices and Dietary Patterns

As *Alberta’s Food and Health Innovation Framework* acknowledges, that there is a “complex behavioural challenge” that must be overcome before health improvements can be achieved by improving the quality of the food supply. “The biggest challenge to creating long-term change,” according to the *Framework*, “is changing individual behaviour through education and fostering motivation to make healthier choices.” In reality, dietary patterns are determined by more than just awareness and motivation—resources, access, the food supply, advertising, and social and demographic factors have a significant impact on food choices and dietary patterns.⁹⁶

Preferences: Taste, Cost, Health and Convenience

Preferences matter. But they are complex and fluid. Both the Conference Board’s CFIC household survey and the Canadian Council of Food and Nutrition’s *Tracking Nutrition Trends* survey⁹⁷ find that nutrition is not the most important consideration in consumers’ food choices, although it is considered important by almost all respondents. In the CFIC survey, quality (84 per cent), safety (72 per cent), and nutritional value (71 per cent) are the top consumer priorities, while the CCFN survey (using a different scale and questions) points to taste (98 per cent), nutrition (93 per cent), and healthfulness (91 per cent). Price or cost is a high priority for 55 per cent of consumers in the CFIC survey and 87 per cent in the CCFN survey.

Yet, there is a difference between what consumers say is important and what their purchasing behaviour reveals. Although consumers rank health higher than price/cost, it does not act as a trump value. As one interviewee remarked, a key challenge for food innovators is that “consumers say they want to buy healthy food, but often don’t follow through, either because it’s more expensive or just doesn’t taste as good to them.”⁹⁸ Another interviewee, who owned two franchises of a quick-serve healthy food restaurant, observed that the business model for inexpensive, convenient healthy food does not work: “The cost of labour and goods to create convenient, healthy food are extremely high, making it a poor business model. This is a major

⁹⁶ The following sections draw in part from Conference Board, *Improving Health Outcomes*. A useful conceptual framework can be found in K. Raines, “Determinants of Healthy Eating in Canada.”

⁹⁷ Canadian Council of Food and Nutrition, *Tracking Nutrition Trends VII*.

⁹⁸ Confidential interview with Alberta association representative.

hurdle for the health food industry because the general population is accustomed to inexpensive fast food.” She has since sold both franchises she once owned.⁹⁹

In some cases, consumers opt for food that is both less healthy and more expensive than alternatives. Consider Albertans’ spending habits. In 2011, Albertans’ spent 5.1 per cent of their food budgets on fresh fruit and 5.4 per cent on fresh vegetables.¹⁰⁰ At the same time, they spent 5.2 per cent on processed meats and nearly 3 per cent on candies and chocolates. Processed foods accounted for 48 per cent of all household food spending in Alberta in 2012, and spending on restaurants meals and restaurant snacks and beverages accounted for 29 per cent. That Albertans’ food budgets are dominated by spending on less healthy processed foods and more expensive restaurant meals suggests that health and price/cost considerations do not always take priority in actual spending.

Societal and demographic shifts in recent decades are also influencing food preferences and consumption patterns:¹⁰¹

- *Education, Employment, and Income.* Higher educational attainment means that the average Canadian consumer may be more knowledgeable about food and nutrition than in the past. However, with the rise of dual-earner households and longer average employment hours, Canadians have greater incentives to turn to convenience foods.¹⁰² In that case, “Canadian consumers’ need for convenience may trump nutrition” and nutritional knowledge.¹⁰³
- *Aging.* The effect of Canada’s aging population on food-consumption is mixed. Our metabolism slows as we age, which means that we need fewer calories, and may therefore demand smaller servings of food.¹⁰⁴ Yet, surveys of adults between the ages of 25 and 64 reveal that the prevalence of obesity increases “significantly with age,”¹⁰⁵ which means that Canadians may be struggling to shift their consumption patterns to reflect their slowing metabolisms.

The upshot is that it is difficult to say precisely how consumers’ preferences shape choices and dietary patterns. There are obvious trends and demographic shifts that incentivize firms to provide different options, but it is not always clear which precise configuration and ranking preferences will emerge. Moreover, although consumers make choices about what they purchase and consume, some of the choices are themselves shaped by other factors such as affordability, supply, advertising, and knowledge.

Knowledge

An important mediating determinant of dietary patterns is knowledge or food literacy.¹⁰⁶ In general, consumers with an understanding of what foods are healthy, how to shop and prepare

⁹⁹ Confidential interview with business executive. Interview by Erin Butler. May 2013.

¹⁰⁰ All data in this section from Statistics Canada, *Survey of household spending (SHS), detailed food expenditures, Canada, regions and provinces, annual (dollars)*.

¹⁰¹ Conference Board, *Valuing Food*, 5-8.

¹⁰² Conference Board, *Valuing Food*, 7-8.

¹⁰³ Conference Board, *Valuing Food*, 9.

¹⁰⁴ Conference Board, *Valuing Food*, 6.

¹⁰⁵ Public Health Agency of Canada, *Socio-demographic and geographic analysis of overweight and obesity in Canadian adults*.

¹⁰⁶ K. Raines, “Determinants of Healthy Eating in Canada,” S9.

meals, and the links between health outcomes and particular dietary patterns are more likely than others to have healthy diets. By contrast, those with low levels of food literacy often have unhealthy diets. Food-related public health strategies to reduce chronic disease and obesity usually emphasize the importance of consumer education, under the assumption that consumers will be better able to manage nutritional risks if they have high levels of food literacy.

Evidence indicates that many consumers at least try to learn about healthy eating. For example, *Eating Well with Canada’s Food Guide*, with its advice on diet, is the second most-requested government document.¹⁰⁷ And findings from the CCFN’s *Tracking Nutrition Trends* survey can be read as indicating that many Canadians’ *views* of healthy eating are generally aligned with the Food Guide even if their behaviour continues to lag.¹⁰⁸

Canadians are also using food labels to find nutrition information. The Conference Board’s household survey reveals that 79 per cent of all Canadians, and 72 per cent of Albertans, say that they examine Nutrition Facts tables when making purchases. But only 43 per cent of Canadians and 33 per cent of Albertans say that they are very or extremely confident about using Nutrition Facts Tables. Thus, even as consumers say that they are interested in healthier foods and understand some dimensions of nutrition, only a minority believe they have the skills necessary to make healthy choices.

The extent to which consumer awareness ultimately influences behavior is a matter of some debate, and the evidence is mixed. Not only do levels of food literacy vary across the population, but knowledge itself is only one factor shaping dietary patterns.¹⁰⁹ It is not enough simply to *know* what constitutes good eating, consumers must have the capacity to put that knowledge to use in buying and consuming food.

Food Affordability

For the vast majority of Canadians food has become more affordable over the years. In 1969, food constituted 18.7 per cent of total household expenditure but dropped to 10.2 per cent by 2009.¹¹⁰ As the Conference Board’s household surveys reveal, considerations such as taste, quality, and nutrition have become key priorities. But for a significant minority of the population, affordability is a very real challenge which severely constrains the amount and quality of food they can access. Some research contends that it is challenging if not impossible “for a low-income family to consume a nutritious diet based on Canadian government recommendations,”¹¹¹ and recent cycles of the Community Health Survey indicate that—for a minority of the population—food security is an issue.

- Food Banks Canada reports that in March 2010, 867,948 Canadians used a food bank—“the highest level on record;”¹¹²

¹⁰⁷ Payne, “What the Food Guide Doesn’t Tell Us.”

¹⁰⁸ Canadian Council of Food and Nutrition, *Tracking Nutrition Trends VII*.

¹⁰⁹ K. Raines, “Determinants of Healthy Eating in Canada,” S9.

¹¹⁰ J. Davidson, “Food eats up less of our spending, but costs us more.”

¹¹¹ Engler-Stringer, “Food, Cooking Skills, and Health: A Literature Review,” 143.

¹¹² Food Banks Canada, *Hunger Count 2010*, 5.

- In 2007-2008 Statistics Canada reported that 7.7 per cent of Canadian households “experienced food insecurity;”¹¹³
- At 6.4 per cent, Alberta and Saskatchewan are tied with the lowest rates of household food insecurity in the country.¹¹⁴

For those Canadians who experience food insecurity, it is unlikely that a food innovation strategy focused on incremental innovation in niche and processed foods will have much impact on their health outcomes. Nor will education and motivational strategies have much impact in light of fixed resource constraints. Given that lower income individuals are also at high risk for food-related chronic diseases, a food innovation strategy that fails to grapple with food affordability will considerably limit its impact on population health outcomes. Policy measures related to income and food access should also be explored.¹¹⁵

Food Supply

Many public health experts believe that the food supply also plays an important role in influencing consumption patterns. The issue is framed as both a matter of the mix of available products and the ingredients and composition of individual products. For example, the Sodium Working Group argues that “the sodium content of commercially prepared foods is a major factor in the high sodium intake of Canadians.”¹¹⁶ A similar rationale was behind Health Canada’s strategy to reduce trans fats in the food supply.

Still, firms will generally supply what consumers will buy (and not simply what they *say* they will buy). The reality is that consumers continue to demand both healthy and unhealthy food options. Thus, the food supply will continue to reflect a mix of healthy and unhealthy options. As one researcher interviewee observed, “if you really want to improve health, tweaking ingredients in existing products won’t work. It can make the healthy healthier, but it doesn’t get to the target groups because either it’s too expensive or there is not enough interest in buying it. Ingredients are important to help fill gaps, but the real thing is getting people to eat better.”¹¹⁷ The challenge for food innovators is to find ways to make products healthier without losing the taste to which consumers have become accustomed and to do so in ways that keep prices at levels consumers will pay. The challenge for policy-makers and society more broadly, however, is to fundamentally change eating habits, not simply tweak the current supply.

Advertising

Finally, there is much concern about the impact that food advertising has on consumption patterns, particularly those of children. The Institute of Medicine, for example, found that television advertising influences both purchase requests and preferences for food and beverages among children between the ages of two and eleven.¹¹⁸ Moreover, several studies show “direct correlations between ad exposure and food preferences...at both the brand (e.g., one fast food

¹¹³ Statistics Canada, *Household Food Insecurity, 2007-2008*.

¹¹⁴ Statistics Canada, *Household Food Insecurity, 2007-2008*.

¹¹⁵ Household food security is the subject of a forthcoming Conference Board report, *Ensuring We Have Enough*.

¹¹⁶ Sodium Working Group, 8.

¹¹⁷ Interview with university researcher. Interview by James Stuckey. January 2013.

¹¹⁸ Institute of Medicine, *Food Marketing to Children: Threat or Opportunity?*, 8.

restaurant versus another) and category (e.g., fast food versus vegetables) levels.”¹¹⁹ Research also suggests that children eight and younger do not fully understand “the persuasive intent of marketing messages,” and that the majority of children who are four years old and younger “cannot consistently discriminate between television advertising and programming.”¹²⁰

These findings suggest that to adjust dietary patterns in the population, it is not enough simply to release new and different products, marketing is also critical. Moreover, if key stakeholders want to nudge the population towards healthier dietary patterns, then changes in the content of advertising will be required. A recent global comparative study revealed that eighty per cent of the food advertisements Canadian children view are for “noncore foods,” a category that “includes products relatively high in undesirable nutrients, including fat and sodium, or energy (as defined in dietary guidelines).”¹²¹ No matter how much food innovation leads to a healthier food supply, so long as unhealthy options and advertising persist, it will be very difficult to shift dietary patterns to improve health outcomes. Indeed, in responding to the question, “Which food innovation trends do you think could have the greatest health impact?” one interviewee simply said that “*marketing* would have the greatest impact.”¹²² There are already many healthy foods available to consumers, but the battle of persuasion complicates the decision-making process.

Consumer Receptivity to New and Emerging Technologies

Food innovation is also challenged by consumer receptivity to new and emerging technologies. As experience with biotechnology and genetically modified organisms (GMO) reveals, how well a product or suite of products fares in the market depends on what consumers believe about the technology that is associated with the innovation. All technology entails risk which can be communicated and managed. But with new and emerging technologies, there is often uncertainty about exactly what the risks are and how they can be managed. Whether consumers ultimately accept a new technology is influenced by how well scientists, businesses, and governments communicate with the public about benefits and risks and, increasingly, the extent to which consumers trust the stakeholders involved in risk communication.¹²³

The innovation opportunities generated by nanotechnology, for example, are the next frontier in technology risk communication and consumer response. Whether stakeholders have learned and will apply the lessons of biotechnology and GMO remains to be seen. One of those lessons is that the public should not only have access to adequate information about risks and benefits, but also opportunities to contribute their thoughts and perspectives to decision-making. Fortunately there is rich expertise in Canada on risk communication and public participation related to new and emerging technologies, including in Alberta.¹²⁴ At present, public awareness of nanotechnology is rather low which creates both challenges and opportunities. Although consumers will need to be engaged and educated, because myths about and aversion to

¹¹⁹ Dietitians of Canada, *Advertising of Food and Beverages to Children*, 3.

¹²⁰ Cairns, Angus and Hastings, *The Extent, Nature and Effects of Food Promotion to Children*, 9.

¹²¹ Kelly et al., “Television Food Advertising to Children: A Global Perspective,” 1733.

¹²² Confidential interview with executive at innovation incubator organization. Interview by Erin Butler. May 2013.

¹²³ Expert Panel on Nanotechnology, *Small is Different*, 95.

¹²⁴ Edna Einsiedel, Professor of Communication Studies, University of Calgary, is one of Canada’s leading experts on technology risk assessment and the role of communication and public participation. <http://www.ucalgary.ca/einsiedel/about>

nanotechnology are relatively low, there is a chance that public dialogue may be informed by science and democratic values rather than ignorance and fear.¹²⁵

Similar debates and concerns are emerging with respect to a range of food safety innovations that rely on technology and processes with which the public is unfamiliar. Irradiation of meat and other products to reduce harmful pathogens, for example, has met with some consumer resistance. In fact, consumer concerns were at the core of Health Canada’s decision not to approve the technology for wider use despite the fact that the scientific assessment revealed that it is safe.¹²⁶ High pressure processing will be another candidate for public discussion. Whether it will achieve widespread use will depend on how the public responds which, in turn, is shaped by how key stakeholders engage and communicate with the public.

Conclusion

Achieving both economic and social objectives with food innovation is a tall order. Jurisdictions are limited by their existing research and businesses capacity, the regulatory environment, and consumer behaviour. As analysis in this chapter reveals, Alberta has research and business strengths in some key areas. Additionally, although regulation and consumer behaviour can impede innovation and health improvements, there are promising efforts to update the regulatory regime, interest in addressing the determinants of dietary patterns, and an opening for some technologies and innovations which, so far, have avoided being cast in a negative light. Given this environment, what food innovation opportunities are emerging for Alberta and which could have positive outcomes for the economy and population health?

¹²⁵ For a discussion of the governance of nanotechnology, see Expert Panel on Nanotechnology, *Small is Different*, 95-100.

¹²⁶ Interview with Health Canada Official. January 2011.

Chapter 4

Emerging Opportunities in Food Innovation

Chapter Summary

- Alberta has a wide range of food research and innovation opportunities that align with market trends and provincial research and industry capacity.
- Varying levels of research and industry strength are found in opportunities in platform technologies; healthy food innovation; functional foods, nutraceuticals, and fortification; food safety innovation; ingredients and value-adding opportunities; snacks and indulgence foods; beverages; and packaging.
- Areas that emerge as strong candidates for further assessment include ingredients and value-adding opportunities; functional foods, nutraceuticals, and fortification; and food safety.
- Other areas worth considering include food biotechnology, food nanotechnology, potato- and pulse-based snacks, and special dietary needs.
- Some opportunities are less promising due to weak research and/or industry capacity in the province, while nearly all face some challenges with respect to regulation and/or consumer receptivity.

Macro-level trends and capacity provide the background drivers and constraints for food innovation, but they do not determine which specific innovations businesses pursue. For example, while consumers want healthier products, businesses can respond in a variety of ways—such as by lowering sodium, eliminating trans fats, or substituting “natural” ingredients for “artificial” ingredients. Similarly, consumers want safer food, but firms have different options to achieve that—such as improving food handling processes or adopting new technologies.

What are the *specific* opportunities for the Alberta food sector based on trends, capacity, and existing firm and industry activities? This chapter highlights a number of innovation opportunities in platform technologies, healthy food, food safety, processing and packaging, and other areas that constitute a “long list” of options for investment by *Alberta Innovates Bio Solutions*. Based on this chapter’s preliminary analysis of opportunities, a shorter list of the most promising opportunities is identified for portfolio, economic, and social analysis in the next chapter.

I. Platform Technologies

Many of the food innovation opportunities available to Alberta depend on developments in key platform technologies—particularly nanotechnology. For example, some reformulation and fortification opportunities require nano-encapsulation technologies. Similarly, certain food safety innovations require nano-biosensor technology. Food innovation in Alberta, then, may depend on building capacity and expertise in a few fundamental platform technology areas. In some cases this will require investment in more basic than applied research—which means that returns on investments will have much longer timelines. But Alberta’s competitive advantage and long-term success in some key areas may ultimately depend on such long-term perspectives.

What are the food-related platform technologies that are both opportunities in themselves and preconditions for success with other food innovation opportunities such as those in health, safety, processing, and packaging?

Nanotechnology

Nanotechnology refers broadly to the science and technique of manipulating matter at extremely small scales. Nanomaterials “have unusual, unexpected properties that are potentially very useful, with applications ranging from new pharmaceuticals to environmental remediation to sports equipment.”¹²⁷ Applications in the food sector are emerging rapidly.

Although numerous scientific developments have involved nanomaterials and/or relied on the unique properties of materials at the nanoscale, *awareness* of these properties and *intentional* engagement with them is quite recent.¹²⁸ In the past two decades, however, advancements in understanding of the functions and structures of various nanomaterials, and a corresponding ability to manipulate them to achieve desired properties and functions, has generated a multitude of possible applications in food products and processes. In fact, research trends are outpacing not only the ability of governments regulate nanomaterials and related products,¹²⁹ but also the ability of the scientists to precisely define and characterize nanomaterials and nanotechnologies for consumers, regulators, and other stakeholders.¹³⁰

Packaging and Testing

Nanotechnology has already enabled the creation of packaging and testing devices that can provide information about the temperature of a product, as well as how long it has been stored.¹³¹ Other packaging applications being developed include indicators for pathogens or other food safety hazards (“intelligent packaging” or “biosensing”)—for example, stickers containing nanoparticles which react and change colour when in contact with certain substances.¹³² Still other applications include testing devices to detect various quality attributes of food products—e.g. the ripeness of an apple.¹³³ These developments could improve the ability of both food companies, as well as consumers, to identify the safety, quality, and other attributes of many food products. In some cases, this could enable Canadian food export growth to the extent that packaging can improve shelf lives and transportability, and safety innovations can further enhance Canada’s reputation as a food safety leader.

¹²⁷ Expert Panel on Nanotechnology, *Small is Different*, 2.

¹²⁸ Louis Pasteur’s investigations into spoilage bacteria in 1866 relied on properties of nanomaterials, and many traditional food manufacturing techniques have involved the creation and use of nano-sized particles—including techniques associated with chocolate, ice cream, and ricotta cheese. But these examples deployed nanoscience only incidentally, not intentionally. National Research Council, *Nanotechnology in Food Products*, 10; House of Lords Science and Technology Committee, *Nanotechnologies and Food*, 7.

¹²⁹ Health Canada, *Nanotechnology-Based Health Products and Food*.

¹³⁰ On nanotechnology’s regulatory challenges see the Expert Panel on Nanotechnology, *Small is Different*. Interviewees for this project noted that many of these challenges persist.

¹³¹ National Research Council, *Nanotechnology in Food Products*, 39-40.

¹³² National Research Council, *Nanotechnology in Food Products*, 39-40.

¹³³ National Research Council, *Nanotechnology in Food Products*, 40.

Nutrition

Nanotechnology is also being used to enhance the nutritional qualities of some foods, as well as to improve how nutrients are delivered and absorbed by the human body. Nanoencapsulation, for example, involves “packaging” a variety of beneficial bioactive compounds (e.g., vitamins, omega-3 fatty acids, pro-biotics) inside certain nano-particles in order to protect the compounds from disintegration or dispersion before they reach those parts of the body that would benefit most from them. Moreover, nanoencapsulation can help to preserve the taste profiles of foods, even as beneficial ingredients and compounds are added, by limiting or preventing contact between taste receptors and the added materials. Research efforts are being made to identify and develop nano-particles that would be the best vehicles for encapsulation—including particles derived from agricultural and forestry biomass sources.¹³⁴ Other efforts are being made to develop ever more sophisticated nanoencapsulation technologies, such as multi-functional nano-layers where, for example, one layer may have an anti-oxidant effect, another layer an anti-microbial effect, and a third offering protection against oxygen or water which could impede delivery or absorption of functional components.¹³⁵

Additionally, nanotechnology may be a fruitful approach to addressing functional challenges associated with reformulating products to reduce sodium. A key feature of nanoparticles is that, owing to their size, they have a “vastly increased surface to volume and surface to mass ratio when compared to larger particles.”¹³⁶ This creates great opportunities for reducing sodium while maintaining taste: “Carving up a grain of salt into these smaller particles increases its surface area a million-fold, which means that your food needs far less salt to give your taste buds the same savoury kick.”¹³⁷ Given that reformulation efforts have been constrained by concerns about effects on taste, this technique is worth further exploration.

Primary Production

There are also a number of emerging applications of nanotechnology to primary production. These include testing devices to provide information about plant health, and “smart-delivery” systems that control the release of pesticides or fertilizers based on what the crops require and other environmental factors (heat and moisture levels, etc.).¹³⁸ These technologies could provide farmers with a way of applying crop nutrients more efficiently, resulting in cost-savings, as well as reducing the over-supply of nutrients to the broader environment (which causes various types of ecosystem degradation). Other technologies could be used to help clean ground water for use in agriculture production—a development that could have important implications for farming in parts of the developing world where clean water is increasingly scarce.¹³⁹

Market Trends

Given that applications of nanotechnology to food are still emerging and evolving, and in light of definitional issues, it is difficult to obtain a clear picture of the size of the market. Some have

¹³⁴ Interview conducted by the Conference Board.

¹³⁵ National Research Council, *Nanotechnology in Food Products*, 41.

¹³⁶ Expert Panel on Nanotechnology, *Small is Different*, 34.

¹³⁷ K. Sanderson, “What you need to know about nano-food.”

¹³⁸ T. Joseph and M. Morrison, *Nanotechnology in Agriculture and Food*, 5.

¹³⁹ T. Joseph and M. Morrison, *Nanotechnology in Agriculture and Food*, 6.

estimated that the global market for food containing nanotechnology reached \$5.8 billion in 2012, representing a growth of 1,400 per cent over the previous six years.¹⁴⁰ Other estimates put this number as high as \$20 billion.¹⁴¹ Country-specific estimates of market share are generally unavailable, owing to a lack of registries or databases of foods containing nanotechnology. The one exception is Japan, where the market for foods containing nanotechnologies is expected to grow from \$220 million (CAN) in 2010 to \$1.65 billion (CAN) in 2020.¹⁴²

Regardless, it is clear that the market for nanotechnology in the food industry is growing rapidly, and has considerable future growth potential. Not surprisingly, there are many companies worldwide that are active in food-related nanotechnology research and development. In 2009, 400 companies around the world were estimated to be undertaking R&D related to nanotechnology in food and food packaging, and this number has likely risen in the intervening years.¹⁴³ Leading jurisdictions include the United States, Japan, and the European Union, each of which has supported nanotechnology research with substantial investments of resources.¹⁴⁴ Many of the world’s largest multinational food companies are also making considerable investments into nanotechnology.¹⁴⁵

Alberta Capacity

Alberta has succeeded in building some important foundations for nanotechnology and food R&D, and is well-positioned to build on its strengths. Important research strengths exist at the National Institute for Nanotechnology in Edmonton, and at the University of Alberta, where researchers are active in the development of nanoencapsulation technologies and applications. Some of this research may support the ability of other researchers and companies to develop and commercialize nutraceuticals that have health benefits for consumers, and that could add value to the province’s agricultural commodities (such as barley, oats, and other field crops).

Knowledge about Alberta’s commercial capacity in the area of nanotechnology and food is limited. Nevertheless, the province has produced some notable commercial successes: including one company that designs diagnostic equipment, to measure micro-ingredients in food substances.¹⁴⁶ This technology can be employed to identify the safety and quality attributes of food products. Other food businesses in a variety of subsectors would likely be interested in nanotechnology applications related to packaging, safety, and nanoencapsulation. Although the interviews with businesses uncovered few specific examples of food businesses working in nanotechnology in Alberta, the potential applications warrant attention.

¹⁴⁰ Cientifica Ltd., *Half Way to the Trillion Dollar Market?*, 3.

¹⁴¹ J. Kuzma and P. VerHage, *Nanotechnology in Agriculture and Food Production*, 7.

¹⁴² House of Lords Science and Technology Committee, *Nanotechnologies and Food*, 17. Note that the source mis-reports the 2020 figure as \$1.65 trillion. We assessed the figure and discovered a miscalculation in the currency conversion. \$1.65 billion is the correct figure.

¹⁴³ House of Lords Science and Technology Committee, *Nanotechnologies and Food*, 17.

¹⁴⁴ T. Joseph and M. Morrison, *Nanotechnology in Agriculture and Food*, 2.

¹⁴⁵ J. Kuzma and P. VerHage, *Nanotechnology in Agriculture and Food Production*, 7-10.

¹⁴⁶ Interview with Dr. Rajan Gupta, Founder and President, SciMed Technologies. Telephone interview by Erin Butler, January 2013.

Challenges

The potential for nanotechnology to impact the food system in a positive way is significant, but stakeholders must be prepared for challenges related to consumer receptivity. Like other technologies that come into contact with, or are incorporated into foods, nanotechnology may face significant scrutiny from consumers concerned about health and safety aspects of nanomaterials. But not only is there a challenge related to consumer perceptions of new and emerging technologies, there are also challenges related to assessing the actual health, safety, and environmental impacts of the use of nanotechnologies and nanomaterials in food and food packaging. Indeed, many of the issues identified by the Expert Panel on Nanotechnology in its comprehensive 2008 assessment, *Small is Different: A Science Perspective on the Regulatory Challenges of the Nanoscale*, remain.¹⁴⁷

Thus, research and innovation related to nanotechnology and food must be accompanied by research into nanotechnology health, safety, and environmental issues. The University of Alberta has faculty—associated with the NINT—with expertise in these issues, as well as in ethical, legal, and social issues related to nanotechnologies, and management and IP assistance.¹⁴⁸ But the developments in nanotechnology application are likely to outpace developments in health and environmental assessment and regulatory capacity.

An additional challenge may be business receptivity to the use of nanotechnology in food innovation. The Project on Emerging Technologies at the Woodrow Wilson International Center for Scholars hosts an inventory of commercial products containing nanomaterials and lists only five products in its food category. Under food storage (including packaging) there are more than 20 entries, and nearly 60 entries in the supplements category.¹⁴⁹ To be sure, it is not an exhaustive global inventory, but it does suggest that uptake by industry is rather limited.

Given concerns about consumer receptivity, known health and environment effects of nanomaterials, and uncertainty about how the regulatory regime will govern nanotechnology, many businesses may adopt a wait-and-see approach. If nanotechnology is to play a greater role in food innovation, advances in risk characterization of nanomaterials and greater regulatory certainty will be needed. In short, there is much potential, but also much risk and uncertainty which may discourage industry. Research investments could focus on these areas in order not only to develop applications, but also to address industry and consumer concerns.

Food Biotechnology

Another important platform technology for food innovation is biotechnology. Unlike nanotechnology, biotechnology in food innovation has been used extensively and is the subject of much debate. Although the manipulation of various crop and animal traits—usually through multi-generation cross-breeding—has been practiced for thousands of years, the science of biotechnology has developed rapidly in the last few decades allowing scientists to add or remove genes, for example, with much greater precision. This has facilitated improvements in food

¹⁴⁷ Expert Panel on Nanotechnology, *Small is Different*.

¹⁴⁸ National Research Council of Canada, *Ethical, Environmental, Economic, Legal, and Social Issues (NE3LS) and NINT*.

¹⁴⁹ Project on Emerging Nanotechnologies, *Food and Beverage Inventory*.

nutrition, safety, and yields—though there is much public concern about the health and safety food biotechnology, particularly genetically modified foods.

Applications of biotechnology occur in crop and animal production and are motivated by a variety of aims and objectives. Examples include:

- Manipulating crop traits to increase “herbicide resistance, insect and virus protection, and tolerance to environmental stressors such as drought”,¹⁵⁰
- Efforts to increase nutritional value by adding or drawing out beneficial characteristics, “such as corn with higher amounts of lysine for animal feed, or vegetable oils with increased levels of omega-3 fatty acids”,¹⁵¹ and
- Animal genomics and genetic engineering which can help “to improve livestock selection and breeding” with a view towards producing higher quality livestock with “enhanced nutritional characteristics.”¹⁵²

In some cases, biotechnology allows for the development of new products or “novel foods” which Health Canada defines as “foods resulting from a process not previously used for food; products that have never been used as a food; or foods that have been modified by genetic manipulation [i.e., genetically modified (GM) foods, genetically engineered foods or biotechnology-derived foods].”¹⁵³

Market Trends

Like nanotechnology, because food biotechnology is a platform technology (or technologies) with a wide range of applications, it is difficult to get a sense of the size of the market. In Canada, not only do the NAICS codes for the industry conflate a number of areas (a point noted by PWC in its assessment of the Alberta economy), but data collected by Statistics Canada are not disaggregated to the level of food-related biotechnology. The problem at the global level is compounded by other categorizations and definitions. The available evidence about biotechnology generally points to mixed performance recently. Although the U.S. biotechnology sector is growing, the European market has experienced some decline and Canadian firms are struggling, according to one analyst.¹⁵⁴ Part of the recent story is likely explained by the recession, but it is difficult to get a clear sense of long-term trends given the paucity of data and economic fluctuations.

Alberta Capacity and Challenges

The biotechnology industry in Alberta is quite young. It is characterized by a fair number of researchers—including in food biotechnology—but much less in terms of businesses that are developing and marketing commercial applications. According to Bio Alberta’s Life Sciences database, there are 605 biotechnology companies or organizations in Canada with 50 based in Alberta. In the “AgBio” biotechnology classification, the database lists 93 companies in Canada,

¹⁵⁰ International Food Information Council, *Background on Food Biotechnology*.

¹⁵¹ International Food Information Council, *Background on Food Biotechnology*.

¹⁵² International Food Information Council, *Background on Food Biotechnology*.

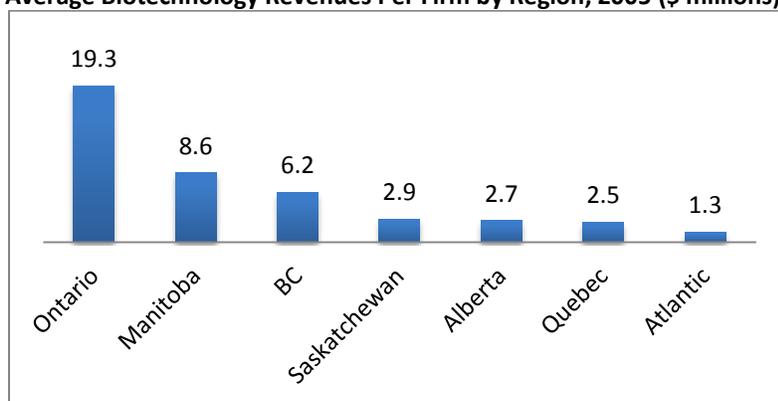
¹⁵³ Health Canada, *Food*.

¹⁵⁴ Ernst & Young, *Beyond Borders*, 34.

with only 8 based in Alberta.¹⁵⁵ It is not clear how comprehensive the database is overall, though a 2010 survey of 133 biotechnology firms by Deloitte found that 10.4 per cent (about 14 firms) categorized themselves as “agricultural biotechnology” firms.¹⁵⁶

Unfortunately Statistics Canada has not collected data on the financial performance of biotechnology firms with any regularity and the last year for which good data was collected was 2005. Recognizing that much has likely changed in the intervening years, the biotech sector in Alberta in 2005 accounted for 3.3 per cent of Canadian biotechnology firms’ revenues. Moreover, at the time, Alberta biotechnology firms also exhibited one of the lowest average revenue-per-firm ratios in Canada at \$2.7 million. (See Chart 16, “Average Biotechnology Revenues Per Firm by Region, 2005”).

Chart 16
Average Biotechnology Revenues Per Firm by Region, 2005 (\$ millions)



Source: Price Waterhouse Coopers

The Alberta biotechnology sector also appears to have difficulty attracting capital. A 2011 Ernst & Young study of the ability of Canadian biotech clusters to attract capital found that Calgary ranked 5th of 6 clusters on total capital raised—outperforming only Ottawa—and last in terms of venture capital raised. Calgary was significantly outperformed by Toronto, Vancouver, and Montreal-based clusters on in terms of raising venture capital.¹⁵⁷

As one analyst observes, Alberta has great infrastructure for research but needs a more “effective and consistent mechanism to transfer technology.”¹⁵⁸ Interviewees also remarked that although Alberta has been able to develop certain aspects of a biotechnology research cluster, key commercial pieces related to global marketing and branding are missing.¹⁵⁹ One researcher interviewee in particular spoke at length about how her team had developed a very promising technology, but could not find an Alberta-based, or even a Canadian-based, company to work with on commercialization. Ultimately the team sold the technology to a firm in Spain who subsequently transferred it to a French firm. The example illustrates that although Alberta has

¹⁵⁵ Bio Alberta, Life Sciences Database. www.bioalberta.com/resources/life-sciences-database

¹⁵⁶ Deloitte, *Life Sciences in Alberta: State of the Industry 2011*, 2, 4.

¹⁵⁷ Ernst & Young. *Beyond Borders*.

¹⁵⁸ Price Waterhouse Coopers, *Alberta Industry Sector Performance and Prospects*, 144.

¹⁵⁹ Interviews conducted by the Conference Board.

promising research capacity in food biotechnology—including researchers oriented to commercial application—the commercial interest and capacity is not robust.

Follow-up interviews with some firms in Alberta’s biotechnology industry revealed that, even some of those who have been touted by government agencies as involved in food regard their food-related activities as so marginal to their core business that they did not believe it would be worth talking about.

Genomics

Within the broader category of biotechnology rests research and innovation opportunities related to genomics as a platform technology. Genomics is a “field of science that studies an organism’s entire genome (DNA sequence)...analyzes the relationship between genetics and traits, and uses the data to answer scientific questions and solve practical problems.”¹⁶⁰ This includes what has been referred to as the “post-genomic” technologies of transcriptomics (i.e., monitoring the “expression levels of thousands of genes simultaneously” under specific times and conditions to characterize mRNA populations); proteomics (i.e., the “study of the protein component of a cell, tissue, or organism at a given time under given conditions”); and metabolomics (which is “focused on the analysis of low-molecular-weight metabolites, which are the end products of gene expression”).¹⁶¹

In the agriculture and food sector, genomics has emerging and potential applications and benefits related to crop and livestock production, food processing, food safety, quality assurance, and diet and nutrition.¹⁶²

- *Crops and livestock.* Genomics research is rapidly producing applications in crop and livestock production with a variety of benefits, including improved pest and pathogen resistance, increased yield and fertility, improved health and quality of products, and decreased environmental impact. Livestock Gentec, for example, reports that application of genomics research can speed up genetic improvement and improve animal health with business benefits including “9-10 per cent lower herd maintenance [and] 20-40 per cent estimated financial gain from using genomics technologies in beef cattle.”¹⁶³ Additionally, use of genomics technologies in livestock production can lead to environmental benefits, including “25-30 per cent lower methane emissions” and “15-17 per cent lower manure, nitrogen, phosphorus, and potassium production.”¹⁶⁴
- *Food Safety.* Genomics research also shows great potential to improve food safety as it has allowed for the identification of the genome sequences of the microbes that cause food borne illnesses.¹⁶⁵ Combined with developments in rapid detection technologies, this holds great promise for the food industry as a whole. As one researcher notes, given that many consumers are more interested in “natural” or “organic” foods—as opposed to those that require “freezing, blanching, sterilisation, curing, and use of preservatives” to maintain

¹⁶⁰ Livestock Gentec, *Genomics: A quick primer*.

¹⁶¹ P. Whitfield, “Exploring genomes in agriculture and food science,” 1047.

¹⁶² L. Brown and F. van der Ouderaa, “Nutritional genomics.”

¹⁶³ Livestock Gentec, *Benefits of Genomics*.

¹⁶⁴ Livestock Gentec, *Benefits of Genomics*.

¹⁶⁵ L. Brown and F. van der Ouderaa, “Nutritional genomics,” 1030.

safety—the detection and control options provided by genomics research could help firms expand their “natural” offerings while maintain or enhancing safety.¹⁶⁶

Recent funding from Alberta Innovates Bio Solutions, Genome Alberta, Genome Canada, and the Canadian Food Inspection Agency for the work of Dr. Linda Chui at the University of Alberta confirms the importance of genomics for food safety and Alberta’s and Canada’s interest in playing an important role. Dr. Chui’s team will “sequence and map the genomes of many *Listeria* strains” with a view towards identifying genetic markers for *Listeria* and using them to “rapidly spot harmful *Listeria* strains in foods and food processing facilities.”¹⁶⁷ Also building on genomics research in food safety, researchers Patrick Pilarski, Linda Pilarski, and Lynn McMullen of the University of Alberta have developed a shoe-box sized testing device which can detect pathogenic *E.coli* while meat is still at food processing facilities.¹⁶⁸ As a platform technology, genomics paves the way for a wide range of similar efforts in food safety that address other pathogens of concern, including *Escherichia coli* (E-Coli), *Campylobacter jejuni*, and *Salmonella* strains.

- *Traceability and Quality Assurance.* Given the ability to characterize and identify specific DNA sequences, genomics creates opportunities to better “trace” and “authenticate” foods and ingredients for various purposes. In the case of food safety, genomics provides a platform for more precise and more complete traceability of specific pathogens, specific food and ingredient origins, and their supply chain paths or histories. In terms of quality assurance, genomics creates opportunities for the “molecular authentication of food ingredients and packaged food products...by manufacturers as part of their quality assurance processes, either to check the provenance of supplied ingredients or to detect for cross-contamination during production.”¹⁶⁹ This would allow companies and governments to ensure that food labelling is “honest and accurate” thereby providing consumers well better information for informed choices.¹⁷⁰

Market Trends

To the extent that developments in agricultural and food genomics will allow Alberta producers and manufacturers to add value to crops and livestock, improve safety, and enhance production, there is strong market potential in this area. Given increasing global demand for protein sources, as well as high expectations of food safety and quality, Alberta livestock producers who apply findings from genomics research and innovation to their production may be able to position themselves to capture more of the export market for higher value crop and meat products. As the global market analysis in Chapter 2 revealed, demand for Alberta’s agri-food exports is rising in key markets—particularly China, Japan, and other markets in Asia and the Middle East. Improvements in quality, value, and safety of these exports—through application of genomics-related research findings—should provide an even stronger foundation for further growth.

¹⁶⁶ L. Brown and F. van der Ouderaa, “Nutritional genomics,” 1030.

¹⁶⁷ Canadian Food Inspection Agency, “Government of Canada and partners fund new genomics research project to eliminate *Listeria* from food supply.”

¹⁶⁸ Alberta Innovates Centre for Machine Learning, *UAlberta and AICML researchers develop E. coli test.*

¹⁶⁹ L. Brown and F. van der Ouderaa, “Nutritional genomics,” 1030.

¹⁷⁰ L. Brown and F. van der Ouderaa, “Nutritional genomics,” 1030.

At the same time, although genomics research has progressed rapidly, especially over the last decade, applications lag research developments. To be sure, many findings have been applied to various aspects of food production and distribution, but a great deal is still in the realm of potential, rather than actual, application and benefit.

Research Capacity

In terms of research capacity, Alberta is well-positioned in genomics. Not only are there many researchers working in various areas of genomics and potential applications, but many are well-coordinated and funded through Alberta Innovates Bio Solutions, Genome Alberta (via Genome Canada), Livestock Gentec, and the Metabolomics Innovation Centre.

- *Genome Alberta* is a publicly funded not-for-profit corporation, under the larger Genome Canada umbrella, that “initiates, funds, and manages genomics research and partnerships.”¹⁷¹ Currently, it supports a number of genomics researchers investigating a range of agri-food related areas including bovine genome sequencing, using genomics to design and improve the quality of oilseeds for global markets, and using genomic tools to better understand and improve crop production (specifically wheat, barley, and rye) in temperate climates.¹⁷²
- *Livestock Gentec*—as profiled in Chapter 3—is an Alberta Innovates Bio Solutions centre based at the University of Alberta. Bringing together partners and collaborators in universities, research networks, livestock industry associations, government agencies and the private sector. It was created in 2010 to continue the work of the Alberta Bovine Genomics Program (ABGP) which “brought together a group of highly skilled scientists in genomics, genetics and bioinformatics” to address “the need for better breeding and management technologies through research” and to “bring the commercial benefits of genomics to the Canadian livestock industry.” In addition to pursuing these activities, Livestock Gentec has broadened its focus to other livestock species, and “expands on existing technology transfer and industry collaboration efforts.”¹⁷³ It is led by University of Alberta professor Graham Plastow who brings a wealth of academic and industry experience to the role.
- *The Metabolomics Innovation Centre (TMIC)* is “a nationally-funded core facility that has a unique combination of infrastructure and personnel to perform a wide range of cutting-edge metabolomics studies for clinical trials research, biomedical studies, bioproducts studies, nutrient profiling and environmental testing.”¹⁷⁴ It also receives funding from Alberta Innovates. Led by the University of Alberta’s Dr. David Wishart and Dr. Liang Li, and the University of Victoria’s Dr. Christoph Borchers, TMIC conducts research across a range of metabolomics specialties and provides a suite of industry-relevant services including, Lipidomics, phytochemical analysis, nutrients (general metabolite analysis), metabolic footprinting and fingerprinting, and food composition analysis and other food- and non-food related research services.¹⁷⁵

¹⁷¹ Genome Alberta, *About Us*.

¹⁷² Genome Alberta, *Agriculture and Forestry*.

¹⁷³ Livestock Gentec, *About Us*.

¹⁷⁴ The Metabolomics Innovation Centre, *About Us*.

¹⁷⁵ The Metabolomics Innovation Centre, *Services*.

Industry Capacity

The situation in terms of industry capacity is harder to analyze given that we are dealing with a platform technology with many sub-fields and potential applications. There are signs that some technology firms may be developing and commercializing food-related genomics applications. Although these firms are not food businesses per se, their activities could contribute to the economic diversification and strength of Alberta’s food sector, and they are employers and revenue-generators in their own right.

However, although genomics research can lead to revenue-generating patents and licenses and there are signs of such activity in Alberta, it appears that Alberta-based firms are not playing a large role in this niche. Livestock Gentec reports, for example, that research conducted under its auspices has led to dozens of patents and exclusive licences and that there are many more underway. But commercialization of research associated with Livestock Gentec has frequently been made possible only through collaboration with international, rather than Albertan or even Canadian, businesses. Livestock Gentec notes that “an international animal healthcare company” has made possible the commercialization of “15 patents through exclusive licensing arrangements.”¹⁷⁶

This suggests that much of the value that could accrue to Alberta is, instead, bleeding out of the province. The returns to the province would be higher if Alberta-based technology and other firms could commercialize genomics research. In this case, Alberta-based genomics companies would be a source of employment and contribute to economic diversification. Regardless, the adoption or implementation by Alberta-based producers and manufacturers of the technologies developed can enhance product quality and improve production efficiency. One expert reports that the Canadian Dairy industry has already achieved \$180 million in such benefits through the application of findings of the sequencing of the bovine genome.¹⁷⁷

Other Technologies

A range of other technologies—including some processing and production technologies—are being explored by Alberta-based researchers with potential benefits for the Alberta food sector, including companies that commercialize the technologies, as well as food businesses that implement them to improve production and reduce costs. Examples include:

- *Plant Lipid Biotech.* Dr. Randall Weselake of the University of Alberta leads a variety of projects related to plant lipid biotechnology. His research program “focuses on understanding the genetic and biochemical regulation of seed oil formation as a basis for developing biotechnological strategies for producing value-added seed oils and related products. The program comprises several major initiatives, such as the Bioactive Oils Program and the Alberta Innovates Phytola Centre, as well as a number of stand-alone projects exploring various aspects of plant lipid biochemistry. Our major emphasis across all of these initiatives is increasing the seed oil content of major oilseed crops and developing specialty oilseeds with modified fatty acid compositions tailored for specific nutritional or industrial

¹⁷⁶ Livestock Gentec, *Research and Innovation*.

¹⁷⁷ Jacques Chesnais, Senior Geneticist, Semex Alliance cited by Livestock Gentec, *Research and Innovation*.

applications.”¹⁷⁸ How this area of research aligns with specific opportunities is explored further in Section V below—Ingredients and Value-Adding Opportunities.

- *Supercritical Fluid Technologies.* Other researchers have conducted work in an area known as supercritical fluid technologies which includes supercritical carbon dioxide for extraction, fractionation, and other reactions. These contribute to opportunities in functional foods as well as ingredients and value-adding opportunities, and delivery systems for bioactives. Applications thus far have focused primarily—though not exclusively—on pharmaceuticals, but opportunities in food are now high on the agenda of key researchers.¹⁷⁹ Key Alberta researchers in this area are Feral Temelli¹⁸⁰ and Marleny Aranda Saldana,¹⁸¹ both based in the Department of Agricultural, Food & Nutritional Science at the University of Alberta.
- *Dairy Processing Technologies.* Lech Ozimek leads research in the area of dairy processing technologies in the Alberta Dairy Association Research Unit at the University of Alberta. With strong links to the dairy processing industry, developments in this research unit are already being commercialized. The research “includes both basic and applied research in process and product development such as: the application of membrane processing, isolation and modification of milk proteins, nutraceutical products from milk and milk products, genetic variants of milk proteins, functional properties of milk ingredients, protein hydrolysates, nutritional and health aspects of milk and milk components, new product & technology development, interaction of milk proteins with hydrocolloids and analysis of milk and dairy products.”¹⁸²

Interviews with other researchers revealed research programs related to other technologies—including membrane processes, extrusion processing, and novel emulsion technologies—however, little in the way of industry application emerged when considering these developments.

II. Healthy Food Innovation

Healthy food is an area of enormous research and innovation potential. Consumer interest in healthier food products, in Canada and around the world, is reflected by the market growth in each of the health-related food trends considered in this section. With the right business and commercialization strategies—including new production and marketing practices, and better linkages between researchers, industry, and supporting organizations—Alberta is well-positioned to succeed in these growing markets.

A key challenge for food researchers and businesses, however, is in pursuing healthy food innovations that consumers will actually purchase. In general, two over-arching themes characterize much of the activity in healthy food innovation—namely, efforts to remove or reduce potentially harmful ingredients and efforts to add or increase potentially beneficial ingredients—in ways that do not diminish a food’s taste, texture, or visual appeal. Simply put, healthy food innovation tends to focus on “taking the bad stuff out, and putting some good stuff

¹⁷⁸ University of Alberta, Randall Weselake. www.afns.ualberta.ca/StaffProfiles/AcademicProfiles/Weselake.aspx.

¹⁷⁹ Interview with Feral Temelli. Telephone interview by James Stuckey, March 2013.

¹⁸⁰ University of Alberta, Feral Temelli. www.afns.ualberta.ca/StaffProfiles/AcademicProfiles/Temelli.aspx.

¹⁸¹ University of Alberta, Marleny Aranda Saldana. www.afns.ualberta.ca/StaffProfiles/AcademicProfiles/Aranda-Saldana.aspx.

¹⁸² University of Alberta, Lech Ozimek. www.afns.ualberta.ca/StaffProfiles/AcademicProfiles/Ozimek.aspx.

in”—sometimes in small or incremental steps. What are the most promising opportunities related to these themes?

Reformulation

Many companies are reformulating their food products, in a market trend referred to as “better for you” (BFY). In some cases this involves removing ingredients that in certain quantities are, or are perceived to be, unhealthy—such as sodium, sugars, carbohydrates, and harmful fats—or, “unnatural”—such as certain additives and preservatives (or what one interviewee referred to as “ates” and “ites”). In other cases, reformulation focuses on increasing the presence of ingredients that are, or are perceived to be, healthy—such as fibre, fruit, and vegetable content.¹⁸³

Generally, reformulation does not involve the addition of new substances to food, distinguishing it from the functional food, fortification, and nutraceuticals trends where additions are made. (These are considered below). But it can be just as technically challenging. Consider, for example, efforts by firms to remove sodium from their processed food products. Simply removing sodium is easy to do, but removing sodium while maintaining taste and functionality requires careful research and experimentation with substitutes. Can taste be maintained? Can the shelf life of products that have relied on sodium as a preservative be maintained? And can the reformulation be achieved while keeping prices in line with what consumers will pay?

Market Trends

Results from the Conference Board’s household survey shows that, of the various new labels consumers confront when purchasing food, “healthy brand” and “Heart and Stroke Healthcheck” labels are more important to them than others. (See Chart 17, “The Importance of Labels”). “Healthy brand” labels include those found on any number of BFY products—such as President’s Choice “Blue Menu” product line or Maple Leaf’s “Natural Country Selections”—and tend to indicate that a product has been reformulated to reduce one or more unhealthy ingredients. The “Heart and Stroke Healthcheck” label indicates that a product has been reformulated to reduce the risk of heart disease or other chronic diseases.¹⁸⁴

Canadian companies have been quick to jump on this food trend and there are numerous examples of existing food products that have been reformulated to contain less of the things that consumers are concerned about, or more of the things that they want. Among food and beverage companies surveyed in 2010, 61 per cent have made products healthier by reformulation.¹⁸⁵ Reformulation might also involve the creation of entirely new product lines: 39 per cent of companies surveyed reported introducing new products that are healthier in certain respects.¹⁸⁶

BFY reformulation is also an important global trend, offering export opportunities to Canadian producers. A 2011 report by Agriculture and Agri-Food Canada (AAFC) notes that global BFY sales in 2010 were US\$160.3 billion, representing market growth of 6.1 per cent for beverages

¹⁸³ Agriculture and Agri-Food Canada. *Health and Wellness Trends for Canada and the World*, 7.

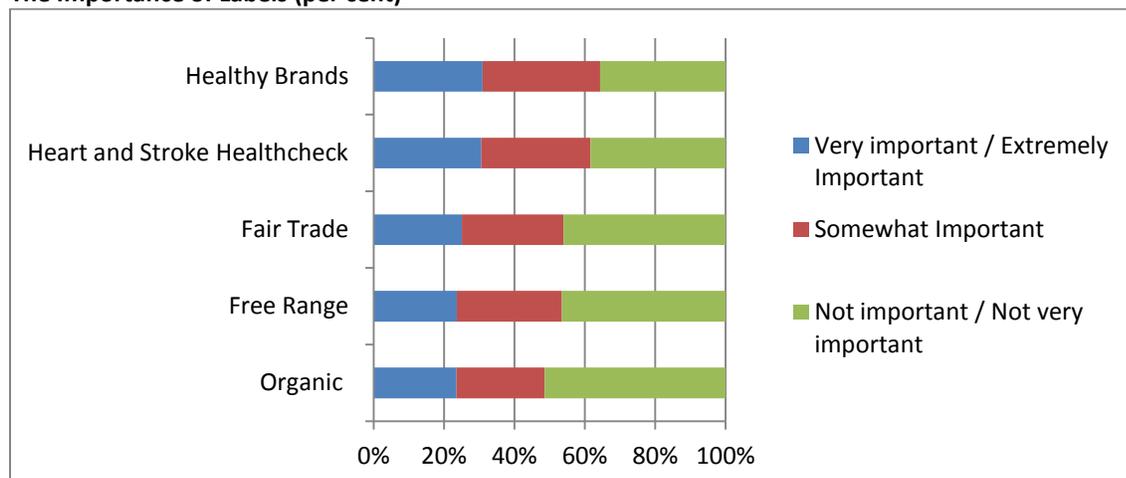
¹⁸⁴ Heart & Stroke Foundation. *What is Health Check?*

¹⁸⁵ Conference Board, *Improving Health Outcomes*, 41.

¹⁸⁶ Conference Board, *Improving Health Outcomes*, 41.

and 4.4 per cent for foods since 2009.¹⁸⁷ The market is expected to grow by a further 24.6 per cent, reaching a value of \$200 billion by 2015.¹⁸⁸ Currently, North America and Europe represent 67 per cent of the BFY market (North America is the largest market with \$57.9 billion in sales, compared to \$50.7 billion in Western Europe), where governments have actively promoted healthier eating to target obesity and other consequences of unhealthy eating habits.¹⁸⁹

Chart 17
The Importance of Labels (per cent)



Source: The Conference Board of Canada

Alberta Capacity

Food businesses in Alberta have been tapping into BFY reformulation trends. For example, some meat processors have reduced the amount of sodium and fat in certain products (e.g. pork sausages). Research trends in meat reformulation are focused on improving the fatty-acid profile of meat. As one interviewee noted, there is an opportunity to incrementally improve the fatty-acid composition of meat over time, which could considerably improve its healthiness.¹⁹⁰

Other research trends involve finding substitutes for preservatives and other additives. Efforts are being made at the applied research level to reduce sodium and increase fibre (especially through pulse and barley ingredients) in collaboration with industry partners. More broadly, in Alberta, as elsewhere, there is a general move towards the increased use of whole grains in food products, and less fat (in particular, trans-fats in processed foods), sugar, and sodium.¹⁹¹

Key research opportunities that emerge in this area relate to finding functional substitutes for ingredients that are being removed. Sodium and sodium chloride substitutes—such as peptides—will be an especially important research area given ongoing efforts by businesses, governments, and consumers to achieve ambitious sodium reduction targets in Canada. Many businesses would value research that identifies and assesses sodium substitutes that achieve the same or better

¹⁸⁷ Agriculture and Agri-Food Canada, *Health and Wellness Trends for Canada and the World*, 7.

¹⁸⁸ Agriculture and Agri-Food Canada, *Health and Wellness Trends for Canada and the World*, 9.

¹⁸⁹ Agriculture and Agri-Food Canada, *Health and Wellness Trends for Canada and the World*, 7, 9.

¹⁹⁰ Interview conducted by the Conference Board.

¹⁹¹ Interview conducted by the Conference Board.

outcomes in preservation, safety, and taste as their existing products that contain sodium. Indeed, a peptides-focused research partnership between University of Alberta researchers and a major Canadian food company is already underway.¹⁹²

Additionally, research efforts in this area must include study of the effects of reformulation on shelf-life and food safety as these are baseline requirements of food businesses. The Agri-Food Discover Place is currently engaged in work in this area, also with support from a major Canadian meat company and the meat packing industry in the province.¹⁹³ Finally, given that the health claims process reportedly requires science produced from a Canadian perspective, many businesses interviewed for this project indicated that it would be valuable for Canadian-based researchers to conduct such research.

Naturally Healthy

Closely tied to the reformulation trend, though distinct, is a trend towards “naturally healthy” food products, prompted by consumers’ perception of a connection between “natural” foods and improved healthiness.¹⁹⁴ As a major agricultural producer, Alberta is well-positioned to tap into these opportunities—for example, through new production or marketing practices (such as “organic”, “free-range”, and “local food”), particularly in the beef, dairy, and horticultural sectors (considered below).

Defining “Naturally Healthy”

As with some other trends, there is ambiguity in the regulatory regime about what exactly counts as a “naturally healthy” food product in Canada and around the world.¹⁹⁵ However, naturally healthy food products are generally considered to be those that contain natural ingredients and that are relatively unmodified.¹⁹⁶ Examples include unprocessed fruits and vegetables, lightly processed food products that contain “all natural” ingredients—and, in the case of meat and poultry, foods that are “free-from” additives or inputs such as growth hormones and antibiotics.¹⁹⁷

An interviewee from a large multinational observed that his company’s innovation efforts are increasingly focused on “the simplicity of the ingredients statement.” Consumers want to know what they are eating, he noted, and a key part of that is being able to read everything in an ingredients list. To achieve this “simplicity” and “readability”, companies must find more “natural” substitutes for a range of existing ingredients.¹⁹⁸

¹⁹² Interview with food industry executives. Interview by Daniel Munro. January 23, 2013.

¹⁹³ Interview with Agri-Food Discovery Place executive. Interview by James Stuckey. February 21, 2013.

¹⁹⁴ See Agriculture and Agri-Food Canada. *Health and Wellness Trends for Canada and the World*.

¹⁹⁵ See Agriculture and Agri-Food Canada. *Health and Wellness Trends for Canada and the World*, 23; and USDA Foreign Agricultural Service, *Canada Trends*, 5.

¹⁹⁶ For example, Canadian Food Inspection Agency guidelines indicate that a food should not be labelled as “natural” if it has undergone significant processing, has had ingredients added to it, or has had any constituents removed or “significantly changed”. See Canadian Food Inspection Agency, *Guide to Food Labelling and Advertising*, Sections 4.7-4.19.

¹⁹⁷ See Agriculture and Agri-Food Canada. *Health and Wellness Trends for Canada and the World*, 23; and USDA Foreign Agricultural Service, *Canada Trends*, 5.

¹⁹⁸ Industry executive interview. Conducted January 23, 2013 by Daniel Munro.

Market Trends

The market for naturally healthy foods can be broken down into distinct segments, each of which is typically associated with foods that have undergone less processing or contain less added ingredients. In terms of meat and poultry products, this could include products produced according to “free-range” production practices—generally requiring that animals can access outdoor, cage-free environments—which some consumers consider to be more natural and healthy.¹⁹⁹ More prominent in the Canadian marketplace is the organic segment, which contains regulated production standards (generally prohibiting the use of synthetic fertilizers, pesticides, growth regulators, feed additives, etc.²⁰⁰), and which consumers often associate with the term “natural.”²⁰¹

The connection between these types of production practices and their human health benefits is not always clear. Regarding organic foods, for example, Canadian regulations on the use of synthetic fertilizers are generally set with wide safety margins and the consumption of non-organic products are not believed to pose toxicological risks to human health. On the other hand, unprocessed (or slightly processed) organic foods may contain less added fat, sugar, or sodium, reducing the risk of chronic diseases relating to the over-consumption of these substances. Regardless of their actual health benefits, however, consumers’ beliefs about the benefits of these products have driven market growth.²⁰² For example, from 2006 to 2011 the number of organic farmers in Canada increased by 4.4 per cent, reaching a total of 3,713.²⁰³

The naturally healthy trend is also reflected by consumer interest in local food. Again, this is based on a consumer perception—accurate or not—that local food is healthier. According to a 2006 Ipsos Reid survey:

- 46 per cent of Canadians believe that local food is healthier for them;
- 44 per cent think it is safer;
- 45 per cent think that it is less likely to contain chemical or synthetic pesticides; and
- 48 per cent think it is not genetically modified—a feature that some consumers believe is bad for their health,²⁰⁴ despite evidence to the contrary.²⁰⁵

While there is no guarantee that food produced and consumed locally will have greater health benefits than those shipped “non-locally”, local food is nevertheless an increasing means by which consumers “express their views about health and nutrition.”²⁰⁶

¹⁹⁹ Conference Board, *Competing for the Bronze*, 16-17.

²⁰⁰ Conference Board, *Competing for the Bronze*, 16.

²⁰¹ Agriculture and Agri-Food Canada, *Canadian Food Trends to 2020*, 34.

²⁰² For example, a study found that the two primary reasons consumers purchase free-range and organic chicken is that it “has no antibiotics or growth hormones and it is healthy.” See L. Neufeld, *Consumer Preferences for Organic/Free Range Chicken*, 15.

²⁰³ Conference Board, *Competing for the Bronze*, 16.

²⁰⁴ Ipsos Reid, *Canadians See Many Benefits Of Locally Grown Food*.

²⁰⁵ Conference Board, *Governing Food*, 27-32; Conference Board, *Competing for the Bronze*, 15-16; Health Canada, “Frequently Asked Questions—Biotechnology and Genetically Modified Foods”; European Commission, *A Decade of EU-Funded GMO Research*, 16.

²⁰⁶ See J. Edge, *Cultivating Opportunities*.

AAFC estimates that the natural healthy food market was valued at \$8.3 billion in 2010, making it the largest health food trend in the country. The international market was valued at \$241.4 billion, and total sales were estimated to reach US\$316.1 billion by 2015.²⁰⁷ However, these numbers do not take into account alternative distribution channels including producer-to-consumer marketing through farmer’s markets, community supported agriculture programs, “pick your own” operations, etc. Each of these contributes to the economic footprint of “local food”, and the amount of food that is sold to many consumers looking for “naturally healthy” options. Farmer’s markets alone have doubled in number since the late 1990s, and in 2008 were estimated to have generated \$1.03 billion in revenue across Canada.²⁰⁸

According to interviewees, Alberta’s horticulture sector is seeing a greater amount of year-round production of many vegetables such as cucumbers, tomatoes, and peppers.²⁰⁹ Moreover, as in other parts of the country over the past decade, Alberta farmer’s markets appear to be growing.²¹⁰ This suggests that Alberta consumers may be increasing their consumption of fresh, unprocessed fruits and vegetables. To be sure, the Conference Board’s household survey revealed that only 20 per cent of Albertans regard local production as a very or extremely important priority when purchasing food—compared to over 40 per cent of other Canadians. But 20 per cent nevertheless constitutes a sizable niche market for a number of food businesses.

Alberta Capacity

There is a perception among some that limited research is conducted by universities or other institutions into horticulture in Alberta—that research funding tends to be more directed towards the food processing and crop agriculture sector. Nevertheless, as one interviewee observed, horticultural companies—including two major vegetable cooperatives—do undertake a limited amount of their own research, including quality analyses that help determine the precise nutrient characteristics of their products.

There appears to be interest among some Alberta-based horticultural businesses and consumers in more research into the nutritional properties and health benefits of fresh fruits and vegetables, which could then provide the basis for health claims on fruits or vegetables (for example, a label applied to the packaging—or, if unpackaged, directly on the fruit or vegetable). Although the horticulture industry in Alberta is not large, some industry stakeholders feel that this could be important to increasing sales and growing the industry.²¹¹

Another interviewee noted that Alberta is ahead of some other provinces in the development of its organic dairy industry, but trails British Columbia, Ontario, and Quebec. The province, with its strengths in meat production, is also realizing market opportunities around organic, free-range, and “all-natural” (additive-free) meat, with companies specializing in free-range pork (see the “Reformulation” section, above).

²⁰⁷ Agriculture and Agri-Food Canada. *Health and Wellness Trends for Canada and the World*, 23.

²⁰⁸ Conference Board, *Competing for the Bronze*, 17.

²⁰⁹ Interview conducted by the Conference Board.

²¹⁰ Interview conducted by the Conference Board.

²¹¹ Interview conducted by the Conference Board.

Special Dietary Needs

The market for foods catering to those with special (health-related) dietary needs—namely, food-related allergies and intolerances—has been growing alongside the increasing number of individuals that have been diagnosed, or otherwise made aware of, such health and diet concerns (which now affect approximately 1 to 2 per cent of the global population²¹²). As the AAFC notes, this market is unique in that for many consumers these foods are a necessity rather than a choice. To be sure, the market is still dominated by educated, middle-class consumers—those who may be better informed about their health needs, and able to afford these specialty products.²¹³

Special dietary needs products are typically marketed as “free-from” various allergens and food intolerance substances.²¹⁴ Although there is some overlap between allergen and intolerance product categories, they respond to conditions that differ in the immediacy and possible severity of their negative health impacts. Food allergies are sensitivities to the proteins contained in some foods, generally causing immediate reactions in the immune system ranging from mild to life-threatening.²¹⁵ Priority allergens identified by Health Canada and allergy associations include peanuts, sesame seeds, milk, tree nuts, soy, eggs, fish, milk, wheat, and other grains.²¹⁶ According to a recent study, 1 in 13 Canadians suffers from a serious food allergy.²¹⁷

Food intolerances, on the other hand, generally do not relate to the immune system.²¹⁸ They are often characterized by an inability to digest or absorb certain food substances, causing reactions in the gastrointestinal system that may take some time to manifest.²¹⁹ About 1.3 million Canadians now have a food intolerance of some kind, and 45 per cent will be affected by a “food related sensitivity at some point in their lives.”²²⁰ The two most common types of intolerance are those relating to lactose and gluten. Lactose intolerance affects at least one person in approximately 15 per cent of Canadian households, and is a result of a person’s inability to digest lactose (sugars from milk) in dairy products.²²¹ Gluten-free products respond primarily to the needs of those suffering from celiac disease—a condition that results in damage to the small intestine and creating difficulty absorbing nutrients when consuming gluten. Celiac disease affects approximately 0.5 to 1 per cent of Canadians.²²² In recent years, interest in gluten-free products has also increased among the non-celiac population.

Market Trends

In Canada, the market for special dietary needs is valued at approximately \$161.3 million USD.²²³ Globally, the food intolerance market reached \$9.1 billion USD in 2011 and is projected

²¹² Agriculture and Agri-Food Canada, *Global Pathfinder Report: Food Intolerance Products*, 3.

²¹³ Agriculture and Agri-Food Canada, *Global Pathfinder Report: Food Intolerance Products*, 3.

²¹⁴ Agriculture and Agri-Food Canada, *Global Pathfinder Report: Food Intolerance Products*, 2.

²¹⁵ Agriculture and Agri-Food Canada, *Global Pathfinder Report: Food Intolerance Products*, 2.

²¹⁶ Agriculture and Agri-Food Canada, *Health and Wellness Trends for Canada and the World*, 24.

²¹⁷ A. Picard, “One in 13 Canadians has serious food allergy.”

²¹⁸ Health Canada, *Food Allergies and Intolerances*.

²¹⁹ Agriculture and Agri-Food Canada, *Global Pathfinder Report: Food Intolerance Products*, 2.

²²⁰ Deloitte, *Food & Beverage Update*, 9.

²²¹ Deloitte, *Food & Beverage Update*, 11.

²²² Health Canada, *Celiac Disease: The Gluten Connection*.

²²³ Agriculture and Agri-Food Canada, *Health and Wellness Trends for Canada and the World*, 24.

to reach \$13.2 billion USD in 2015. In 2010, North America represented 43 per cent of global sales. Top food intolerance categories worldwide are gluten free (29.4 per cent), lactose-free (39.1 per cent), diabetic foods (16 per cent), and other milk alternatives (15.5 per cent).²²⁴ Deloitte estimates that the gluten-free market in the US alone is \$2.7 billion USD, and it is expected to reach US\$6.0 billion by 2015.²²⁵ In 2010, the top gluten-free product introductions in Canada were potato chips, processed snacks, functional drinks, dips, dressings, other savory snacks, confectionary, cookies, juices, and breakfast cereals.²²⁶

The recent phenomenon of non-celiac consumers purchasing and consuming gluten-free products may complicate attempts to track market trends in coming years.²²⁷ As a result, gluten-free product lines in Canada are becoming more extensive and the industry will likely become more sophisticated, offering an expanded array of innovative product offerings.²²⁸ How many of the non-celiac consumers will be long-term, or merely short-term fad, consumers of gluten-free products remains to be seen. Companies considering products in this market must be very careful in interpreting recent trends.

Alberta Capacity

Some Alberta companies have established themselves in the special dietary needs market segment, and have achieved degrees of commercial success. Among the leading firms is Kinnikinnick Foods Inc which produces a range of gluten-, nut-, and dairy-free baked products. Based in Edmonton, the company has established a strong footprint in North American. The firm employs 70 people, had sales of \$9.4 million in 2011, and sells 65 per cent of its products in the United States.²²⁹ The company utilized initial funding from AVAC to build a production facility that has been described as “one of the most allergy-friendly production facilities in the world.”²³⁰ Another company has developed a peanut butter substitute, made entirely from peas. The product is marketed as entirely nut-free, gluten-free, and trans-fat free. Other Alberta companies are achieving market success for baked goods that meet special dietary needs such as allergen and gluten-free.

III. Functional Foods, Fortification, and Nutraceuticals

Functional foods, fortification, and nutraceuticals are important areas of food science innovation that offer potential for economic growth and improved health. Although there is some confusion about what each term entails, and corresponding legal and regulatory inconsistencies across jurisdictions, a key feature of these innovations is that they provide “physiological benefits and/or reduce the risk of chronic disease beyond basic nutritional functions.”²³¹ In this, they go beyond healthy product reformulation by promising specific disease-fighting or health-promoting benefits.

²²⁴ Agriculture and Agri-Food Canada, *Global Pathfinder Report: Food Intolerance Products*, 2.

²²⁵ Deloitte, *Food & Beverage Update*, 9.

²²⁶ Alberta Agriculture and Rural Development, *Opportunities in the Gluten-free Market*.

²²⁷ Deloitte, *Food & Beverage Update*, 9.

²²⁸ Deloitte, *Food & Beverage Update*, 12.

²²⁹ J. Wulf, “Feeling Good about Gluten-Free”; J. Leeder, “Kinnikinnick Foods offers salvation for gluten-averse consumers.”

²³⁰ AVAC Ltd., *AVAC Helped Kinnikinnick Fine Tune Their Recipe for Success*.

²³¹ Health Canada. *Policy Paper - Nutraceuticals/Functional Foods and Health Claims On Foods*.

Fortified and functional foods are food products that are generally in a form that is recognizable as food (whereas nutraceuticals may not be). They have been enhanced with health-promoting components, which can come from a wide variety of sources including animals, vegetables, fruits, micro-organisms, specialty crops, oilseeds, grains, cereals, herbs, botanicals, and marine life.²³² Examples of fortified and functional foods include eggs with omega-3 fatty acids; cereals with enhanced beta-glucan; juices enriched with calcium, foods with increased antioxidants; probiotic bread; canola oil enhanced with carotenoids; and wheat enhanced with lutein.²³³

Fortified and functional foods might also contain a nutraceutical—defined by Statistics Canada as “a product that is isolated or purified from foods that is generally sold in medicinal forms not usually associated with food, such as powders, tablets or capsules.”²³⁴ However, the multi-functionality of nutraceuticals allows them to be productized in different ways, either as ingredients for fortified and functional foods, or sold on their own as medicinal and nutritional supplements or “natural health products” (sometimes also referred to as nutraceuticals). Examples of nutraceuticals include pro-biotics (sold both in capsule form as well as in functional foods such as probiotic-enhanced yogurt), antioxidants, omega-3, or plant material such as ginseng.²³⁵

Dietary supplements, in particular, have become a focus of much innovation. The range of supplements available is wide and includes both herbal and non-herbal types. Herbal supplements include Echinacea, Ginkgo Biloba, St John's Wort, Flaxseed/Linseed, and others which many believe have beneficial health effects. Non-herbal supplements include omega fatty acids 3-6-9 (fish and non-fish), glucosamine, and calcium, mineral, probiotic, and protein supplements.²³⁶

There is significant debate about the extent to which dietary supplements actually produce health benefits for consumers and whether the risks of consuming certain supplements outweigh any benefits. A recent meta-review of research on the health benefits of dietary supplements concludes that “with the possible exception of Vitamin D (in elderly patients) and omega-3 fatty acids (in patients with cardiovascular disease) there is no data to support the use of dietary supplements in Westernized populations...indeed, the data suggest that certain commonly used dietary supplements (β -carotene, vitamin A, and vitamin E) may be harmful.”²³⁷ Additionally, there is a lack of clarity about whether dietary supplements should be regulated as food or pharmaceuticals.

Market Trends

As functional foods, fortification, and nutraceuticals often emerge from cutting-edge advancements in food science, consumer awareness and understanding of their health benefits—and corresponding market opportunities—is always developing. Many nutraceuticals being explored for fortified and functional food application are still relatively unknown among many consumers. However, others (such as omega-3 enhanced products) have had a market presence for some time—helping to foster stronger awareness among Canadians about functional foods

²³² AAFC, *Canada's Functional Food and Natural Health Products Industry 2005*.

²³³ See Health Canada, *Policy Paper - Nutraceuticals/Functional Foods and Health Claims On Foods*; and AAFC, *Canada's Functional Food and Natural Health Products Industry*.

²³⁴ Statistics Canada, *Functional Foods and Nutraceuticals*, 12; AAFC, *Health and Wellness Trends for Canada and the World*, 15.

²³⁵ AAFC, *Canada's Functional Food and Natural Health Products Industry*.

²³⁶ Euromonitor International, *Vitamins and Dietary Supplements in Canada*.

²³⁷ P. Marik and M. Flemmer, “Do Dietary Supplements Have Beneficial Health Effects in Industrialized Nations,” 158, 161.

and their benefits. One study found that, as early as 2004, many Canadians were already aware of the value of functional foods in addressing certain chronic diseases, and were on the whole “very positive about functional foods.”²³⁸

In 2010, Canada’s fortified and functional food market was estimated to be worth approximately \$4.9 billion and is projected to increase to \$5.8 billion by 2015.²³⁹ While this is a sizable market, it places Canada in the middle of the pack in terms of per capita spending on fortified and functional foods and beverages in selected developed countries. In 2010, per capita spending on these products by Canadians amounted to \$140 (USD) which lags the United States at \$167 (USD) and Japan at \$158 (USD), but exceeds per capita spending in the United Kingdom of \$115 (USD).²⁴⁰ (The global market for the dietary supplements segment amounted to \$49.4 billion in 2011, while retail sales of dietary supplements and vitamins in Canada is projected to grow marginally to \$1.3 billion Canadian by 2017).²⁴¹

Nevertheless, for firms in the fortified and functional foods and beverages space, not only is the growth trajectory strong in the Canadian market, but the global market is projected to nearly double from an estimated \$127.4 billion (USD) in 2010 to \$244.6 billion (USD) by 2015.²⁴² Greatest demand is likely to be for fortified and functional foods that contain the nutraceuticals glucosamine, whey protein, sterol esters, probiotics, and omega-3 fatty acids.²⁴³ By 2007, Canada had 689 firms active in the field of functional foods and natural health products.²⁴⁴ These firms spent approximately \$209 million on R&D and produced 265 registered trademarks, 93 patents, and 217 trade secrets.²⁴⁵ As a proportion of the global market, however, Canadian firms constitute only a sliver.²⁴⁶ The industry is characterized by many small firms struggling to overcome the challenges of financing and scale-up.²⁴⁷ Larger, multinational firms tend to conduct much of their R&D in the United States.²⁴⁸

In the dietary supplements segment, Jamieson Laboratories has a large footprint, accounting for 22 per cent of sales of vitamins and dietary supplements in Canada in 2012.²⁴⁹ The remainder of the market is rather fragmented with many small manufacturers competing against some medium-sized direct (internet) sellers and other firms.²⁵⁰

Alberta Capacity

Considering Alberta Innovates’ interest in both economic and health-related benefits of research investments, there is *prima facie* strong case for investment in research and innovation in this

²³⁸ Klimas, Brethour, and Bucknell. *Opportunities for the Canadian Agri-Food Industries in Functional Foods*, 4.

²³⁹ AAFC, *Health and Wellness Trends for Canada and the World*, 17.

²⁴⁰ AAFC, *Health and Wellness Trends for Canada and the World*, 17.

²⁴¹ Euromonitor International. *Vitamins and Dietary Supplements in Canada*.

²⁴² AAFC, *Health and Wellness Trends for Canada and the World*, 18.

²⁴³ AAFC, *Health and Wellness Trends for Canada and the World*, 18.

²⁴⁴ Statistics Canada. *Results from the Functional Foods and Natural Health Products Survey*, 7.

²⁴⁵ Statistics Canada. *Results from the Functional Foods and Natural Health Products Survey*, 7.

²⁴⁶ Klimas, Brethour, and Bucknell. *Opportunities for the Canadian Agri-Food Industries in Functional Foods*, 20.

²⁴⁷ Klimas, Brethour, and Bucknell. *Opportunities for the Canadian Agri-Food Industries in Functional Foods*, 6.

²⁴⁸ Klimas, Brethour, and Bucknell. *Opportunities for the Canadian Agri-Food Industries in Functional Foods*, 6.

²⁴⁹ Euromonitor International. *Vitamins and Dietary Supplements in Canada*.

²⁵⁰ Euromonitor International. *Vitamins and Dietary Supplements in Canada*.

area. The key question, however, is whether Alberta researchers and businesses have the capacity to benefit from investments in this area.

Research Capacity

Much of the activity around functional foods, fortification, and nutraceuticals research and development in Alberta appears to occur within universities, other research organizations, and, on occasion, their spin-off companies. Less appears to stem directly from Alberta businesses.²⁵¹ Key research strengths exist at the University of Alberta, and the Leduc Food Processing Development Centre.²⁵² Within these institutions, Alberta boasts some of the most promising functional foods, fortification, and nutraceuticals research and innovation in Canada. Much of this is geared around the strategic priority of leveraging Alberta’s strengths in primary production to bolster value-chains within the province.²⁵³ Opportunities exist for both crop and livestock agriculture.

For example, research efforts are being made at the University of Alberta to extract beta-glucan, as a functional component, from barley.²⁵⁴ Other efforts are being made to develop functional, pulse-based ingredients, by fractionating pulses into their protein, starch, and fibre components—ingredients that can then be utilized as health-promoting ingredients for other food products.

There is also potential for Alberta’s dairy industry. Dairy proteins in powder form, for example, could serve fast-growing developing markets, such as China, which have an increasing need for quality proteins (with Canada’s reputation for food quality and safety providing added market value).²⁵⁵ Some of these proteins are currently available as waste extracts—for example, from cheese manufacturing. Other opportunities include research on extracting ganglioside molecules from cow’s milk, which could be used to help combat certain diseases and infections (such as “Beaver Fever”)—and which could have significant value in developing countries.²⁵⁶ And there are ongoing efforts to find new ways to add omega-3 to dairy products—though regulatory challenges and market structure issues make this kind of innovation especially challenging.²⁵⁷

Other research efforts hold potential for Alberta’s meat industry. Researchers at the University of Alberta are exploring ways of extracting bioactive compounds from poultry that could have a range of functional/fortification applications. For example, research is being conducted on how to extract chondroitin from the cartilage of processing broiler chickens, which could be made into functional ingredients to prevent joint abnormalities such as arthritis. One researcher noted that whereas chondroitin is often sourced from beef or pork, developing a poultry source for the substance would create additional marketing avenues, such as Halal.²⁵⁸

²⁵¹ Interviews conducted by the Conference Board.

²⁵² Department of Foreign Affairs and International Trade. *Functional Foods and Natural Health Products*, 8.

²⁵³ The province generates approximately one-third of Canada’s agricultural output, with key commodity strengths in barley, canola, and wheat. See Department of Foreign Affairs and International Trade. *Functional Foods and Natural Health Products*, 8.

²⁵⁴ One interviewee noted that there is so much research being done in barley that it is hard to acquire sufficient supplies to meet researchers’ needs.

²⁵⁵ Interview conducted by the Conference Board of Canada.

²⁵⁶ Interview conducted by the Conference Board of Canada.

²⁵⁷ Interview conducted by the Conference Board of Canada.

²⁵⁸ Interview conducted by the Conference Board of Canada.

Research related to choline is also prominent in Alberta. Associated with B-vitamins, choline contributes to liver health and neurological functioning. Choline deficiencies among pregnant women may increase the risk of neural tube defects in infants. Researchers associated with the University of Alberta have been investigating novel plant and animal sources of choline with a view towards producing choline supplements or encapsulation in food. However, with the exception of some support from the Dairy Farmers of Canada, an industry association, the researchers face a lack of consumer and industry awareness of the importance of choline, and expect weak commercialization progress until dietary reference guidelines in both Canada and the United States are updated to reflect insights about the importance of choline.²⁵⁹

Industry Capacity

Companies focusing on functional foods or natural health products have a sizable presence in Alberta. There were 251 such companies in Alberta in 2010 (see Table 1, “Functional Food and Natural Health Product Firms and Specialists by Province”)—though other reports note that this had declined slightly to 241 by 2012.²⁶⁰ This lags well behind Ontario (1,464), Quebec (875), and BC (614), but there is evidence of an emerging critical mass or cluster of such firms in the province.

Especially interesting about the situation in Alberta is the ratio of functional food specialists to functional/natural health food companies in the province. With a ratio of 1 specialist for every 6 companies, Alberta functional/natural food firms have better access to specialist support than peer companies in all but three other provinces. Given that lack of expertise is often cited as a barrier to innovation and growth, the situation for Alberta’s functional/natural health food companies suggests that there may be opportunities for more innovation and growth.

Table 1
Functional Food and Natural Health Product Firms and Specialists by Province (2010)

Province	Functional Food or Natural Health Product Firms (Rank)	Functional Food Specialists (Rank)	Number of Firms per Specialists (Rank)
Ontario	1464 (1)	131 (1)	11.2 (7)
Quebec	875 (2)	98 (3)	8.9 (6)
BC	614 (3)	109 (2)	5.6 (3)
Alberta	251 (4)	41 (4)	6.1 (4)
Nova Scotia	229 (5)	19 (7)	12.1 (8)
Newfoundland	147 (6)	5 (10)	29.4 (10)
New Brunswick	145 (7)	8 (8)	18.1 (9)
Manitoba	84 (8)	28 (6)	3.0 (2)
Saskatchewan	69 (9)	31 (5)	2.2 (1)
PEI	51 (10)	7 (9)	7.3 (5)

Source: Statistics Canada.

²⁵⁹ Interview with Catherine Field, University of Alberta. Interview by James Stuckey. February 2013.

²⁶⁰ Department of Foreign Affairs and International Trade. *Functional Foods and Natural Health Products*, 8.

A possible risk in this area is that the leading functional food companies in Alberta tend to be much smaller, and thus less well-resourced, than the leading functional food companies in Ontario. Whereas the Alberta functional food space includes activities by companies like Bunge, BioNeutra, Ceapro, and Sino Veda Canada, in Ontario functional foods activities are led by some of the largest food companies in the world, including General Mills, Kellogg’s, Kraft, Nestle, and Unilever.²⁶¹ These are companies with global reach and significant resources and thus would present tough competition for smaller Alberta-based companies in functional foods. According to one analysis, although Alberta functional food companies have seen some success, many struggle to retain market share and often must partner with larger companies in order to survive and grow.²⁶²

IV. Food Safety Innovation

Food safety is another important area for Alberta. Not only is safe food a high priority for consumers, it is also emerging as an area of global competitive advantage for the Canadian food industry. Yet, as food production expands and confronts new complexities (such as reformulation), enhancing food safety has become a significant demand for the food industry. And doing so in ways that maintain taste and prices that consumers will pay adds to the challenge. Fortunately, there is a great deal of research and innovation aimed at meeting the challenge.

It is hard to overstate the importance of food safety to the meat industry in Alberta. The economic impact of the discovery of a BSE-infected cow in 2003 by the Canadian Food Inspection Agency was catastrophic. One analysis suggests that the Canadian meat industry as a whole lost \$5.4 billion through reduction in demand and prices as world markets for Canadian meat collapsed due to global consumer perception of the food safety risk. Additionally, governments paid an estimated \$2.5 billion to defray these costs.²⁶³ More recently, at least 18 people fell ill due to consumption of *E. Coli*-tainted meat originating from the XL Foods Inc. plant in Brooks, Alberta, leading to the recall of nearly 2,000 beef products and further damage to consumer confidence in the food supply.²⁶⁴ Moreover, the devastating 2008 *Listeriosis* outbreak which led to 23 deaths and serious illness in 57 others is still fresh in the minds of many Canadians, and food safety remains a major concern and priority for the public, business, government, and researchers.²⁶⁵

Research and innovation to sustain and enhance food safety is therefore critical in protecting the Alberta food industry from possible future losses owing to failures in food safety. Given that 47 per cent of the Alberta food manufacturing sector is focused on meat products, and that 72 per cent of Canadians regard food safety as a very or extremely important priority, this is clearly a wise emphasis.

Yet, meat is not the only food safety area with implications for Alberta. A wide range of pathogens pose a threat to the safety of the food supply, including fruits and vegetables, dairy products, and some processed foods. In general, Canada’s food safety system does a good job of protecting consumers from food safety hazards, but there are opportunities to use better

²⁶¹ Invest in Canada, *Functional Foods and Natural Health Products*.

²⁶² Interview conducted by the Conference Board.

²⁶³ Conference Board, *All Together Now*, 16.

²⁶⁴ R. J. Lewis, A. Corriveau, and W. R. Osborne, *Independent Review of XL Foods Inc. Beef Recall 2012*

²⁶⁵ S. Weatherill, *Report of the Independent Investigator into the 2008 Listeriosis Outbreak*.

technologies and processes to improve performance further.²⁶⁶ Relative to key international competitors—such as the United States, Australia, and others, Canada as a whole could do better in food safety. (See Table 2, “Rate of Food Borne Illness by Pathogen”).

Table 2
Rates of foodborne illness by pathogen in Canada, the U.S., and Australia (Rate per 100,000 population)

	Rate per 100,000 population					
	2000	2002	2004	2006	2008	2009 ²⁶⁷
<i>Campylobacter</i>						
Canada	39.10	36.70	29.90	-	-	-
United States	15.37	13.34	12.79	12.70	12.68	-
Australia	108.00	113.00	116.20	111.10	107.50	-
Germany	-	68.34	67.50	62.97	78.70	-
United Kingdom	11.01	-	78.95	85.10	91.23	-
<i>E. coli</i>						
Canada	9.78	3.95	3.43	3.20	-	1.80
United States	2.03	1.69	0.90	1.30	1.12	1.53
Australia	0.10	0.10	0.10	0.10	0.20	-
Germany	-	1.37	1.10	1.43	1.10	-
United Kingdom	-	-	1.70	2.13	2.05	-
<i>Salmonella</i>						
Canada	20.50	20.70	17.20	18.00	-	18.03
United States	14.08	16.20	14.61	14.72	16.20	16.18
Australia	32.30	40.00	39.00	39.90	38.40	-
Germany	97.00	87.75	-	63.62	52.20	-
United Kingdom	24.57	24.32	23.87	22.54	18.85	-

Source: Charlebois, *World Ranking: 2010 Food Safety Performance*.²⁶⁸

Industry Interest

Industry interest in research and innovation focused on food safety is very high. As the Conference Board’s food industry survey reveals, while less than a third of Alberta food businesses regard innovation focused on products (28 per cent), processes (28 per cent), or inputs (21 per cent) as very or extremely important factors for their future success, food safety innovation

²⁶⁶ As we note in our report on food safety in Canada, “although there are close to 6.8 million cases of food-borne illness annually in Canada, the overwhelming majority are mild and involve minor discomfort and inconvenience. Despite increasing public anxiety about food safety, it is exceptionally rare for debilitating illness or death to result from the consumption of unsafe food in Canada. Yet there is no reason to be complacent. There is room to improve Canada’s food safety performance....When high-profile outbreaks—or even increased fears of outbreaks—occur, businesses can experience significantly reduced sales, high recall costs, and lower consumer confidence. All of these things not only threaten Canadians’ health, but can negatively affect the economic competitiveness and viability of the food industry, which we rely on to meet our nutritional and dietary needs.” D. Munro, J.C. le Vallee, and J. Stuckey, *Improving Food Safety*, 1.

²⁶⁷ The 2009 figure for Canada is taken from PHAC, *National Enteric Surveillance Program, Annual Summary (2009)*, Table 3. The 2009 figures for the United States are from CDC, *Summary of Notifiable Diseases – United States, 2009*, Table 7. See Munro, Le Vallee, and Stuckey, *Improving Food Safety*.

²⁶⁸ Results for *Listeria* were not included in the global ranking.

is considered a priority of nearly half (46 per cent) of those firms. Among Alberta-based food processors and retailers, in particular, this rises to 56 per cent. Indeed, many in the Alberta food industry recognize the importance of food safety innovation and the risks of not doing enough to maintain and enhance it. Moreover, many interviewees noted that global trade opportunities may increase as Alberta’s and Canada’s reputation for producing safe food is enhanced.

Alberta Capacity

Alberta has a great deal of research activity in food safety. This includes:

- Alberta-based genomics research shows potential to help improve food safety through the identification of the genome sequences of the microbes that cause food borne illnesses.²⁶⁹ Dr. Linda Chui’s team will “sequence and map the genomes of many *Listeria* strains” with a view towards identifying genetic markers for *Listeria* and using them to “rapidly spot harmful *Listeria* strains in foods and food processing facilities.”²⁷⁰
- Another important food safety research role being played by Alberta facilities relates to “challenge” studies. Researchers at the University of Alberta, for example, are frequently called upon by Maple Leaf Foods, among other companies, to conduct “challenge studies” which require the exposure of products to certain harmful pathogens. As Maple Leaf and other businesses do not want the pathogens in their own labs for fear of cross-contamination, they will often send that work out to university-based researchers. Along with the University of Guelph, the University of Alberta appears to be playing a large role in this area in Canada.²⁷¹
- Researchers at the University of Alberta have drawn on genomics research to develop a rapid detection technology for *E. Coli*. Led by Lynn McMullen (Faculty of Agricultural, Life and Environmental Sciences) and Linda Pilarski (Faculty of Medicine and Dentistry), and with assistance from faculty in computer science, the team is developing an on-site detection test that can be used at food processing facilities to detect the presence of *E. Coli* in products in less than an hour and at substantially lower cost to producers. The researchers expect that the technology can be adapted to help detect other food-borne pathogens and contribute to food safety in the province’s food sector.²⁷²
- CanBiocin is an Alberta-based company doing innovative food safety research. Founded as a spin-off company from University of Alberta-based research, CanBiocin’s main product is a food safety ingredient that is derived from lactic-acid bacteria which already occurs in food. The company took the ingredient out, turned it into a concentrated “spray” or “additive” which slows the growth of *Listeria* in meat, achieved regulatory approval from Health Canada, and now sell it to food processors as a food safety product. (The company is also exploring lactic-acid bacteria-based pro-biotics).²⁷³

²⁶⁹ L. Brown and F. van der Ouderaa, “Nutritional genomics,” 1030.

²⁷⁰ Canadian Food Inspection Agency, “Government of Canada and partners fund new genomics research project to eliminate *Listeria* from food supply.”

²⁷¹ Interview with Janet Clark, Senior Director, Insights and Innovation and Colin Farnum, Head, R&D, Protein Division, Maple Leaf Foods. Telephone interview by Daniel Munro, January 2013.

²⁷² R. Maurier, “UAlberta researchers develop *E. coli* test for food processing facilities.”

²⁷³ Interview with Denise Carlson, Director of Operations, CanBiocin. Telephone interview by James Stuckey, February 2013.

- The Alberta Prion Research Institute (APRI), which is part of Alberta Innovates Bio Solutions, uses its \$50 million budget to “support top researchers working on solutions to the serious scientific and socioeconomic challenges associated with prion diseases in animals and prion and prion-like diseases in humans.”²⁷⁴ APRI invests in both fundamental and applied research across a range of areas—including bovine spongiform encephalopathy (BSE) and chronic wasting disease (CWD)—and is attentive to the demands of both understanding and implementing research findings to improve food safety. By 2011, APRI had committed \$28.5 million to research projects led by 38 principal investigators at the University of Alberta, the University of Calgary, and two in industry.²⁷⁵

High-Pressure Processing

Many regard high-pressure processing (HPP) as one of the most promising breakthroughs in food manufacturing technology.²⁷⁶ HPP uses compressed cold water to subject foods to extremely high pressures—up to 4,000 times atmospheric pressure—in order to reduce and deactivate pathogens, denature proteins, and increase the shelf life of products.²⁷⁷ In this way, HPP can achieve the same benefits of thermal techniques for sterilization and preservation, but without changing a food’s taste or texture, or damaging vitamins or other nutritional compounds (e.g., bioactives).²⁷⁸ The process can be applied to products in their final packages, regardless of their size or shape, produces no processing by-products, and has lower risk post-processing contamination.²⁷⁹

HPP offers businesses a range of potential cost-saving and value-adding benefits—it can “facilitate the production of food products that have the quality of fresh foods but the convenience and profitability associated with shelf life extension.”²⁸⁰ By increasing the shelf life of a product, businesses can save on transportation and storage costs or they can transport products over longer distances (a great benefit for exporting companies, or those in geographically extensive markets such as Canada). HPP can be more energy efficient than other processing techniques.²⁸¹ And, as a reliable method for improving the quality and safety of food products, the technology can reduce insurance and labour costs—not to mention the costs of recalls, and the loss of brand reputation and market share following major food safety lapses.²⁸²

The health benefits of HPP for consumers include better preservation of the nutritional components of foods that currently undergo other methods of sterilization and preservation. In addition, by eliminating or reducing the need for sodium-based preservatives, HPP could play an important role in reducing the sodium content of processed foods.²⁸³ HPP also creates the

²⁷⁴ Alberta Prion Research Institute, *About Us*.

²⁷⁵ Alberta Prion Research Institute, *Ingenuity, Investigation, Invention*, 4, 5.

²⁷⁶ D. Sun and T. Norton, “Recent Advances in the Use of High Pressure.”

²⁷⁷ D. Sun and T. Norton, “Recent Advances in the Use of High Pressure.”

²⁷⁸ See D. Sun and T. Norton, “Recent Advances in the Use of High Pressure” and R. Sharma, *Market trends in high pressure processing (HPP) food*.

²⁷⁹ R. Sharma, *Market trends in high pressure processing*, 15.

²⁸⁰ D. Sun and T. Norton, “Recent Advances in the Use of High Pressure.”

²⁸¹ R. Sharma, *Market trends in high pressure processing*, 15.

²⁸² D. Sun and T. Norton, “Recent Advances in the Use of High Pressure.”

²⁸³ E. Watson, *Could HPP be the secret weapon in the battle to reduce sodium?*

opportunity for other additives to be reduced, and for healthier product reformulations—e.g. salad dressings that use yogurt rather than mayonnaise as a base.²⁸⁴ HPP therefore lends itself to “clean” product marketing that taps into consumer interest in more natural, healthier, and additive-free food products.²⁸⁵

Market Trends

HPP technology was first commercialized in Japan in the early 1990s, with companies in other parts of the world following thereafter.²⁸⁶ Since 2000, there has been an almost exponential uptake of HPP around the world.²⁸⁷ In 2010, Canada was estimated to have the third largest number of HPP installations in the world (after the United States and Mexico).²⁸⁸ Although the exact market share of HPP around the world is unknown, in 2011 it was estimated to fall between \$2 and 3 billion USD.²⁸⁹

According to a 2008 analysis, HPP is applied most extensively to the following product categories (in order of size): vegetables, meat products, juices and beverages, seafood and fish, and other products categories.²⁹⁰ Some food products are currently not suitable for HPP, including those that contain air (such as various baked goods), foods with very low water content (spices, dried fruits, or powders), or foods that require rigid packaging (such as glass or cans).²⁹¹ However, new applications of HPP are being developed. For example, although the application of HPP to dairy products is rare, new market opportunities include using HPP to assist in lowering the risk of *listeria monocytogenes* contamination in cheeses made from raw milk.²⁹²

Ultimately, the feasibility of applying HPP to a new product or market depends on a combination of factors. At a cost of approximately \$1 million US for even small-scale HPP machines, capital costs can be expensive, particularly for smaller processors.²⁹³ This has produced a trend towards sharing central HPP facilities among several companies.²⁹⁴ HPP also faces consumer receptivity issues. Although many consumers value the improved “naturalness”, nutritional value, and taste of HPP foods, others are skeptical about the benefits, or require more information about the technology.²⁹⁵ And implementing HPP across the food system involves overcoming many regulatory hurdles. Health Canada has approved the use of HPP on some “ready-to-eat” meat and fish products, as well as apple sauce, but regulatory approval for additional applications of the technology has been slow.²⁹⁶

²⁸⁴ E. Watson, *Could HPP be the secret weapon in the battle to reduce sodium?*

²⁸⁵ V. Balasubramaniam, D. Farkas, and E. Turek, “Preserving Foods through High-Pressure Processing.”

²⁸⁶ R. Sharma, *Market trends in high pressure processing*, 2.

²⁸⁷ D. Sun and T. Norton, “Recent Advances in the Use of High Pressure.”

²⁸⁸ R. Sharma, *Market trends in high pressure processing*.

²⁸⁹ R. Sharma, *Market trends in high pressure processing*.

²⁹⁰ R. Sharma, *Market trends in high pressure processing*.

²⁹¹ R. Sharma, *Market trends in high pressure processing*.

²⁹² P. Clark, “High-Pressure Processing Research Continues.”

²⁹³ R. Sharma, *Market trends in high pressure processing*.

²⁹⁴ E. Watson, *Could HPP be the secret weapon in the battle to reduce sodium?*

²⁹⁵ A. Sonne, et al., “Consumer Perception of the Use of High-Pressure and Pulsed Electric Field Technologies in Food Production,” 123.

²⁹⁶ Food companies in Canada that are notable for their application of HPP include Maple Leaf Foods, Santa Maria Foods, and Ocean Choice International. See Conference Board, *Competing for the Bronze*, 28.

Alberta Capacity

Alberta was the first province to introduce a commercial-capacity HPP facility, at the Leduc Food Processing Centre, to support applied research and commercialization of HPP foods.²⁹⁷ The facility gives companies the opportunity to test HPP technology and develop products for market trial—an opportunity that some are taking advantage of.²⁹⁸ According to interviewees, some companies in the meat products sector are also making investments into their own HPP equipment although there is a lack of data regarding how widespread these investments are.²⁹⁹

Irradiation

Irradiation is a well-established practice that could reduce food safety risks but whose widespread adoption has faced obstacles in Canada because of questions about potential health impacts. On some estimates, as much as a quarter of the volume of harmful pathogens, such as *Campylobacter*, could be eliminated from various foods, such as poultry, through irradiation.³⁰⁰ In fact, irradiation is used in the food systems of more than 40 countries, including Canada where it is permitted for use on potatoes, onions, wheat, flour, spices, and dehydrated seasonings. The Canadian Cattleman’s Association recently submitted paperwork to Health Canada to restart a long-dormant process for approval of beef irradiation in Canada.³⁰¹ And a company based in Port Coquitlam, B.C.—Iotron Industries—is making major investments in irradiation technology based on expectations that it will be approved.³⁰²

Yet, consumers have been wary of irradiation and many are concerned that it introduces a new, unnecessary, hazard into food production. In particular, consumers have been concerned about the possibility that vitamins and other nutrients may be eliminated through irradiation and many believe that there is a risk of radiation poisoning from foods that have undergone the process. Although Health Canada’s review of irradiation ten years ago revealed that the process was safe, consumer concerns caused the agency to withhold approval.³⁰³

Market Trends

There are many opportunities for the use of irradiation in the Alberta food sector which could serve to enhance the reputation for safe foods originating from the province. And there will likely be need for additional scientific studies to assist with Health Canada’s review process.

Alberta Capacity

However, there does not appear to be much in the way of research and industry capacity in the province to be a leader in irradiation science. In short, this is a potential process innovation in the Alberta food sector which may require some technical and expert support, but which does not

²⁹⁷ Canadian Meat Science Association, *High Pressure Processing*.

²⁹⁸ Interview conducted by the Conference Board.

²⁹⁹ Interview conducted by the Conference Board.

³⁰⁰ Hein.

³⁰¹ Canadian Cattleman’s Association, *CCA submits request for approval of beef irradiation to Health Canada*.

³⁰² B. Bouw, “Bacteria beware.”

³⁰³ Interview with Health Canada Official. January 2011.

itself constitute an opportunity for the province to be an industry leader in the development and sale of the technology itself.

Development and Diffusion of Food Safety Processes

In general, much of the food industry is aware of and has implemented food safety processes and standards, such as HACCP. Indeed, some sectors of the food industry are required to implement and adhere to rigorous HACCP plans. Others, however, are relatively new to the game. Some interviewees noted that more parts of the food system need to be convinced of the effectiveness, and subsequently be encouraged to adopt HACCP programs, including trucking, food banks, and water bottlers. At the same time, reinforcing food safety management in processing and other parts of the food sector can contribute to the province’s food safety reputation. The Alberta HACCP Advantage program has been critical in this regard.³⁰⁴

Market Trends

Food safety process improvement and innovation is becoming even more important in core areas of Alberta’s food economy, as the introductory analysis of this food safety section revealed. In addition to research investments in food safety technologies, investments in food safety process innovation—including development of sophisticated management systems and capacity—would constitute an important protective and preventive investment for Alberta’s food industry. To that end, investments in research of best practices, training for processors, transporters, and food service businesses and other organizations, and education and awareness for households and consumers are advisable.

Alberta Capacity

Research funders such as Alberta Innovates Bio Solutions and the Alberta Livestock and Meat Association have made food safety a priority given its importance to the Alberta food sector and the prevention of health and economic risks posed by food safety incidents. There is also existing and emerging capacity among Alberta-based researchers and other stakeholders with respect to processes.

V. Ingredients and Value-Adding Opportunities

In the agri-food sector, adding value to products can generate many positive benefits for businesses, consumers, and the economy as a whole. Alberta has an interest in building from its strengths in primary production in order to help diversify the province’s economy, through the creation of new businesses or industries that make use of the province’s agricultural products and ingredients.³⁰⁵ For producers, adding value to agricultural products and ingredients can support price premiums that cannot be achieved by the sale of bulk commodities alone.³⁰⁶

³⁰⁴ Alberta Agriculture and Rural Development, *Alberta HACCP Advantage*.

³⁰⁵ Sift Every Thing, *An Evidence-Based Guide to the Sector’s Strengths and Innovation Options*, 2

³⁰⁶ For additional information on ways of improving business performance in agriculture, see Stuckey and Butler, *Seeds for Success*.

The principle means of adding value to agricultural production is through the additional processing, extraction, or utilization of agricultural components—although producers make use of other strategies before the farm-gate, including changes to marketing, production practices (e.g. organic), or adding business lines (such as agri-tourism). Scientific and technological advancements make possible an expanding array of new product possibilities using agricultural materials, including functional foods and nutraceuticals. These technologies and innovations are considered in detail in Chapter 4.

Adding value to Alberta’s agricultural output has been a priority of the Alberta government for some time. During the late 1990s, the government recognized the importance of supporting R&D and the commercialization of new agri-food products to help achieve this end.³⁰⁷ It also recognized that developments were likely to begin in areas of existing agricultural strength and capacity.³⁰⁸ It was noted at the time that Alberta’s producers were already actively pursuing a variety of value-added opportunities. Those coming from Northern Alberta, for example, were estimated to include: “meat products; perogies; baked goods; jams and jellies; honey; cosmetic creams; frozen berries; canola oil, dehydrated alfalfa and other forage products; grass seeds (cleaned and screened); and elk velvet.”³⁰⁹

Regional organizations in Alberta have also taken steps to bolster investment in value-added opportunities, understanding its connection to economic growth and prosperity. The RISE Business Development Initiative in the Alberta Foothills Region identifies agriculture as a key target industry for investment, noting that “Alberta’s strategic location, transportation infrastructure and extensive and diverse agriculture staples base crop industry are well-positioned to be further leveraged with investment in value-added activity.”³¹⁰ It notes that investment opportunities exist in organic foods and horticulture in addition to food processing and production. The region is already home to major food processors including Cargill Foods, Highwood Distillers, and Rollover Premium Food (a premium pet food producer).³¹¹

Developing food manufacturing industries that source ingredients from the province’s agricultural producers is a key way of achieving value-added opportunities for the economy as a whole. Some analysts have estimated that most ingredients for Alberta’s food manufacturing sector come from outside the province, with the exception of meat production.³¹² Alberta’s food manufacturing sector is the third largest manufacturing sector in the province by GDP, and exports have grown over the years.³¹³ However, the rate of growth of food processing shipments has also slowed, and now lags that of other major provinces.³¹⁴ Supporting new value-chains between Alberta producers and food manufacturers may help foster new business and economic growth.

³⁰⁷ Northern Labour Market Information Clearinghouse, *Training for Value-Added Agriculture: Opportunity Report*, 3

³⁰⁸ Northern Labour Market Information Clearinghouse, *Training for Value-Added Agriculture: Opportunity Report*, 3

³⁰⁹ Northern Labour Market Information Clearinghouse, *Training for Value-Added Agriculture: Opportunity Report*, 3

³¹⁰ Alberta Foothills Investment & Business Site Selection Guide, 9.

³¹¹ Alberta Foothills Investment & Business Site Selection Guide, 9.

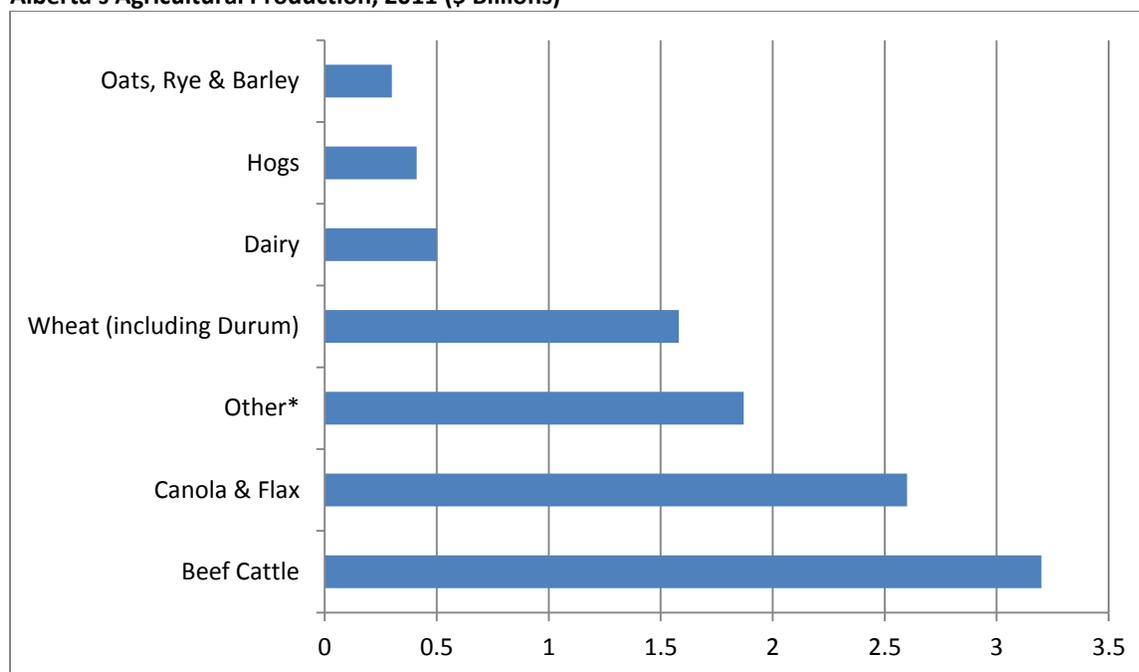
³¹² Sift Every Thing, *An Evidence-Based Guide to the Sector’s Strengths and Innovation Options*, 4.

³¹³ Government of Alberta, *About the Industry*.

³¹⁴ In 2010, this growth rate was just over two per cent, compared to approximately 2.3 between 2005 and 2009—making it about a “middle of the pack” performer compared to other Canadian provinces. See AAFC, *An Overview of the Canadian Agriculture and Agri-Food System 2012*, 86.

There are many ways that value can be added to agriculture. In considering the opportunities that are open to Alberta, it is useful to focus on areas where some capacity already exists—in terms of industry or research activity in the province—and can be leveraged. Value-added opportunities are available in all agricultural sub-sectors—but those sub-sectors that have the largest share of agricultural GDP in the province (see Chart 18), may represent the greatest potential for economic impacts in the province. The following analysis focuses primarily on opportunities for new product innovation and commercialization.

Chart 18
Alberta’s Agricultural Production, 2011 (\$ Billions)



*Includes speciality cash crops, honey, poultry, eggs, program payments, etc.

Source: Highlights of the Alberta Economy, 2012.

Livestock and Beef

Given the size and importance of Alberta’s livestock and beef industry, new product development in this area could hold great promise for the province’s economy.

The Alberta Livestock and Meat Agency (ALMA) plays an important role in fostering research and innovation in the sector. ALMA was started in 2009 with the objective of improving the international competitiveness of the livestock and meat sector. The agency has an annual budget of \$35 million and supports R&D, commercialization, industry development, and other strategic initiatives for the sector. One representative from ALMA notes that bio-actives derived from meat and targeted to specialty markets are an area of particular focus. For example, chondroitin can be made into functional ingredients to support joint health. This can now be sourced from poultry, opening up the market for different faith-based diets (halal, etc.). Research at the

University of Alberta is being conducted on how to extract chondroitin from the cartilage of processing broiler chickens.

The ALMA has supported a wide variety of R&D projects in the province that each holds the potential for developing greater value-added opportunities in the livestock and meat sector. For example, research supported at the University of Alberta aims to identify innovative functional ingredients from poultry waste sources including gelatin and “leftover meat proteins” that could add an enhanced, salty flavour to food products.³¹⁵ The work has already received support from Maple Leaf Foods Canada. Other research at the University of Alberta is being conducted to improve the fatty-acid composition of beef, which could help to incrementally improve its healthiness.

Cash Crops

Alberta generates approximately one-third of Canada’s agricultural output.³¹⁶ Key commodities include canola, wheat, barley and oats. Many of these commodities contain components and materials that, with additional processing, can be made into higher-value products for sale to consumers in Canada and around the world. A considerable amount of research is supported to help food businesses in Alberta tap into this abundance: Basic research is conducted at the University of Alberta, and applied research and commercialization support services at the University of Alberta’s Agri-Food Discovery Place, as well as the Leduc Food Processing Development Centre’s Agrivalue Processing Business Incubator.

Cereals are Alberta’s major crop category and therefore have considerable potential for use as ingredients in new food products. Researchers at the University of Alberta have been active in developing fractionation techniques to isolate bioactives in cereals as well as oilseeds. In particular, the development of new extraction techniques for the fractionation of fibre and beta-glucen—especially from oats and barley—holds out promise for a range of new functional food and nutraceuticals applications. Some attempts have been made to commercialize this extraction research, with mixed success: ultimately, commercialization will depend upon more food companies reformulating or creating products that utilize bioactives from Alberta agricultural sources.

Developments in nanotechnology also represent value-chain opportunities between Alberta producers and other food businesses. Nano-technology makes possible the encapsulation of bioactives for better delivery and absorption throughout the human body (see “Nanotechnology”, page 41). According to one researcher, nutraceuticals derived from agricultural commodities in the province are a “major trend” in food innovation.³¹⁷ Encapsulation products could derive from the province’s rich supplies of barley and, although product volume would likely be minimal, it would nevertheless represent a high-value application of the commodity that could have multiple applications in nutraceuticals and personal care products.

³¹⁵ ALMA, *2011 to 2012 List of Projects*.

³¹⁶ Department of Foreign Affairs and International Trade. *Functional Foods and Natural Health Products*, 8

³¹⁷ Interview with Lingyun Chen (University of Alberta), telephone interview by James Stuckey.

Other research at the University of Alberta, in conjunction with the Alberta Innovates Phytola Centre, focuses on plant lipid biotechnology: including how oils and fats are formed in canola and flax seeds, and techniques to increase the amount of oil yielded. The work could lead to the development of improved oils with bioactive properties—including anti-cancer properties—that, in the words of one researcher, “would be of benefit to nutraceuticals and health promoting companies.”³¹⁸ Other applications include oils that can be used as an alternative to fish oil; that could be fed to poultry to enhance the omega-3 content of eggs; or that could be used in the aquafeed industry.³¹⁹

Some of this work has been done in conjunction with Cargill Canada Inc. However, according to one interviewee, commercial capacity in this area is generally weak. One start-up venture focused on oil-derived health and personal care products—SemBioSys Genetics Inc.—has since ended operations. The interviewee notes that much can be learned about the biotech industry from Saskatchewan, where biotech companies have the support and resources of a research park and incubator based in Saskatoon—in addition to the services of Ag-West Bio Inc., an agency that supports commercialization activities in biosciences.

Pulses are another area of value-added opportunity for the province. There is a growing recognition that pulses and pulse ingredients have many applications beyond their traditional use as whole or split products (split pea and ham soup, baked beans, etc.).³²⁰ Pulse ingredients can be fractionated into starch, protein, and fibre components—health promoting ingredients that can be used in a range of other product applications. For example, snack foods made from pulse ingredients have been explored by researchers at the Leduc food processing facility.³²¹ Efforts were made to “develop and evaluate the use of pulses, such as chickpeas, lentils, and yellow peas in creating a commercially viable, mass market option to corn tortilla chips.”³²² It is anticipated that the growing market for healthy product reformulations could open up considerable potential for value-added opportunities in the pulse sector, given the crop’s healthy nutritional profile.

Dairy

Alberta’s dairy sector accounts for approximately \$500 million in annual revenues and value-add opportunities could generate a significant economic impact—though the dairy sector is sometimes considered a weak innovator. As one interviewee, representing a major dairy association, explained: “milk and dairy products have had a halo about them as being nutritious, healthy, and pure foods—the closer you can get to milk itself, the better.”³²³ Regulatory hurdles create additional challenges for the marketing of dairy innovations—as one industry representative noted, “the minute you add something to milk or cheese, you can no longer call it dairy.”³²⁴ Supply management is also considered to reduce the flexibility of the industry to innovate.

³¹⁸ Interview with Randall Weselake (University of Alberta), telephone interview by James Stuckey.

³¹⁹ Interview with Randall Weselake (University of Alberta), telephone interview by James Stuckey.

³²⁰ Interview with Leanne Fischburn (Alberta Pulse Growers), telephone interview by James Stuckey.

³²¹ Pass the Pulse Chips Please.

³²² Pass the Pulse Chips Please.

³²³ Interview with David Wong (Alberta Dairy Council), telephone interview by James Stuckey.

³²⁴ Interview with Ted Lawson (Saputo), telephone interview by James Stuckey.

But if some in the industry are unwilling or unable to venture into new product territory, this does not mean that other innovators are not prepared to find ways of using dairy-based ingredients in new products; dairy foods, as with other agricultural products, are versatile, and functional components can be extracted or isolated for a range of value-added applications. For example, research and commercialization efforts in the province to develop a bioactive from cow’s milk which reduces inflammatory signals in the intestine could provide prevention against certain inflammatory diseases and infections.³²⁵ The bioactive is also toxic to the organisms that cause “beaver fever”—representing potential value for markets in developing countries.

Utilizing dairy protein in products such as protein powder is also a significant opportunity for value-add in the sector. Producers stand to benefit from making better use of dairy surplus and selling it as a powder.³²⁶ Likewise, cheese producers could make better use of waste extracts from their manufacturing processes to convert into powders. Promising market opportunities for dairy protein sourced from Alberta producers could be found in China and other fast-growing developing markets that are looking for trusted, quality sources. In the view of one interviewee, protein products bearing the Canadian quality “stamp of approval” would find considerable demand in these markets.

VI. Snacks and Indulgence Foods

Despite increasing consumer concern about health and nutrition, demand for snack and indulgence foods remains strong. In general, consumers purchase snack and indulgence foods not only because they enjoy them but also, increasingly, as convenient meal replacements and/or simply as sources of nutrition and energy. The ability of Alberta businesses to succeed in this category will depend in large part on their ability to respond to a new range of consumer desires and expectations—including demand for premium, better-value, and even “healthier” snack and indulgence products³²⁷—through new product innovation.

Defining Terms

There is some overlap between snack and indulgence food product categories. The AAFC notes that snack foods are “by their very nature [...] considered to be an indulgence.”³²⁸ Snack foods refer primarily to “savoury or salty snacks which include potato chips, tortilla chips, hard pretzels, popped popcorn, processed seed snacks, roasted peanuts and other nuts, and pork rinds.”³²⁹ This would include some foods that would be considered indulgences—which are defined more narrowly as foods that are not particularly healthy or nutritious, including confectionery (foods that are typically rich in sugar, such as chocolate and desserts). For this reason, snack food and confectionary markets are considered separately below.

Not all snack foods, however, are indulgences. The snack foods category is expanding to include, for example, “processed seed snacks, nuts and dried fruit and nut mixtures, as well as baked

³²⁵ Interview with Tom Clandinin (University of Alberta), telephone interview by James Stuckey.

³²⁶ Interview with Ted Lawson (Saputo), telephone interview by James Stuckey.

³²⁷ Agriculture and Agri-Food Canada, *Consumer Trends: Salty Snack Food in the United States*, 2.

³²⁸ Agriculture and Agri-Food Canada, *The Canadian Snack Food Manufacturing Industry*, 1.

³²⁹ Agriculture and Agri-Food Canada, *The Canadian Snack Food Manufacturing Industry*, 1.

snacks offering healthier choices.”³³⁰ In fact, many consumers now look for snack foods that, in the words of one industry observer, “offer a compromise between health and indulgence,”³³¹ such as snacks that are lower in sodium, contain lower or healthier fats, or include added vitamins or fibre.³³² Other consumers regard snack foods as an opportunity to “experiment with new or innovative foods”³³³—all important considerations when assessing the market opportunities available to Alberta agri-food businesses.

Market Trends

Consumers in Canada and around the world purchase and eat a great deal of snacks and indulgence products. A 2012 study of snacking habits among American consumers shows that 49 per cent snack between one and two times a day and another 43 per cent snack between three and four times a day.³³⁴ Canadian snack patterns likely resemble, to some extent, those of their American neighbours, given cultural similarities. One estimate holds that Canadians snack more than 300 times a year.³³⁵ Most consumers (60 per cent) snack for enjoyment rather than hunger, although many others snack to satisfy hunger (34 per cent); to eat a “mini meal” (9 per cent); or to help them meet nutritional requirements (8 per cent).³³⁶

Albertans have a healthy appetite for snacks and indulgence products (see Chart 19). Spending on these products has generally increased since 2010, particularly in confectionary-related product categories: sugar and confectionary, candies and chocolates, and other chocolate confections. The most popular snack or indulgence food in Alberta remains, by far, bakery products—although spending on these products declined slightly from 2010 to 2011.

Per capita spending on confectionary provides a rough comparison of consumption levels across jurisdictions. Data from 2010 indicates that Australians and New Zealanders spend the most per capita on confectionary (\$351 US); followed by Western Europeans (\$180); and North Americans (\$132).³³⁷ While this might indicate untapped market potential in the province, the limited size of the Alberta market as a whole means that Alberta businesses that want to compete in this sector should look to export opportunities in addition to domestic ones to grow their businesses. These opportunities are considered below.

³³⁰ Agriculture and Agri-Food Canada, *The Canadian Snack Food Manufacturing Industry*, 2.

³³¹ Joel Gregoire, “Snacking through the ages.”

³³² Canadian Manufacturing, *Snack foods are claiming more market share*.

³³³ Alberta Agricultural and Rural Development, *Consumer Corner: Snacking Trend, an Opportunity for Restaurants*.

³³⁴ Sally Lyons Watt, *State of the Snack Industry*, 5.

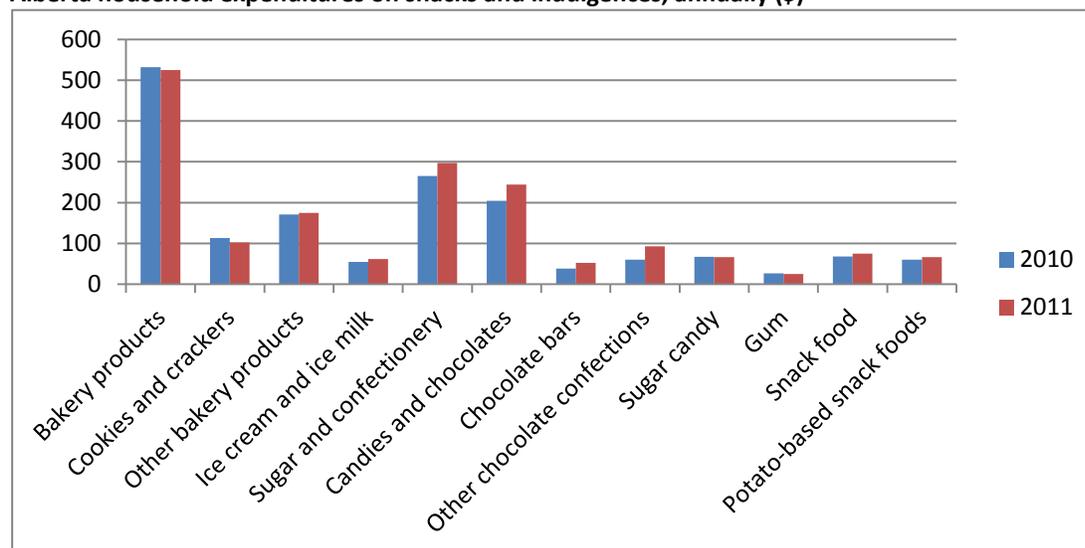
³³⁵ Joel Gregoire, “Snacking through the ages.”

³³⁶ Sally Lyons Watt, *State of the Snack Industry*, 5-10.

³³⁷ Agriculture and Agri-Food Canada, *Global Packaged Confectionary Trends*, 4.

Chart 19

Alberta household expenditures on snacks and indulgences, annually (\$)



Source: Source: Statistics Canada. Table 203-0028; The Conference Board of Canada.

Opportunities

The snack food manufacturing industry in Canada accounts for approximately 2.5 per cent of total food manufacturing. Although this makes it a relatively small part of overall food manufacturing, there has been steady growth over the past decade.³³⁸ In 2009, total production was valued at \$2.1 billion, with \$166.5 million in exports.³³⁹ Of these exports, 90 per cent go to the United States.³⁴⁰

According to AAFC data, Alberta accounted for 23 per cent of snack food manufacturing in Canada in 2009, with 13 establishments located in the province—second only to Ontario.³⁴¹ Much of this manufacturing occurs in the area of potato-based snacks—also Canada’s largest category of snack food export overall.³⁴² Alberta’s processing potato industry includes several major processing companies with strengths in potato chip and french fry manufacturing, which together utilize about 80 per cent of potato production in the province.³⁴³ Export statistics for processed potato products from 2003 to 2012 show that the lion’s share of exports is made to the United States (see Chart 20). Shipments to other trading partners—China, Japan, and South Korea—show stagnating growth over the past decade, while shipments to Mexico have slightly increased.

The snack food market is projected to grow, and demand for new and innovative products may create opportunities for Alberta businesses to venture into new product areas that make a broader use of the province’s agricultural output. As the AAFC notes, there is considerable potential for growth in niche product areas, including “snack food products made from non-traditional ingredients, such as pulses (e.g., beans, lentils or peas), rice and other grains, dried fruits and

³³⁸ Agriculture and Agri-Food Canada, *The Canadian Snack Food Manufacturing Industry*, 1.

³³⁹ Agriculture and Agri-Food Canada, *The Canadian Snack Food Manufacturing Industry*, 2.

³⁴⁰ Agriculture and Agri-Food Canada, *The Canadian Snack Food Manufacturing Industry*, 6.

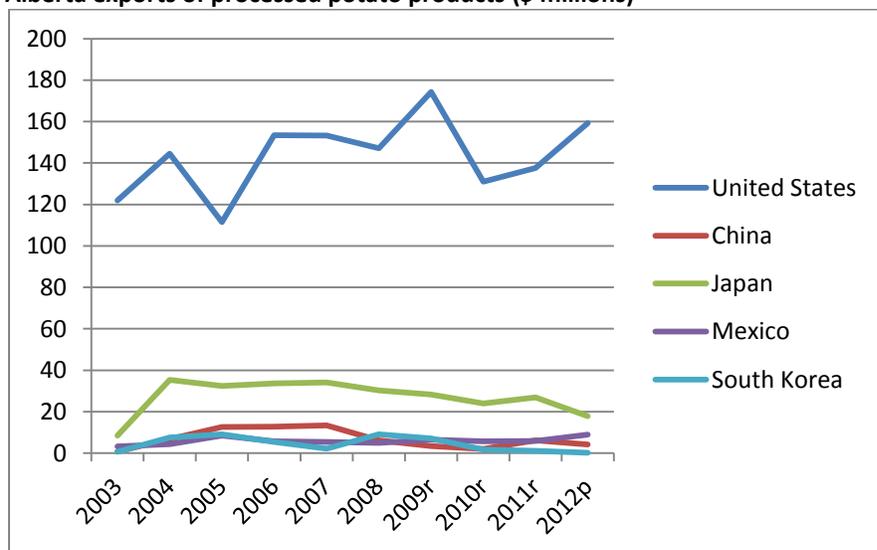
³⁴¹ Agriculture and Agri-Food Canada, *The Canadian Snack Food Manufacturing Industry*, 3.

³⁴² Agriculture and Agri-Food Canada, *The Canadian Snack Food Manufacturing Industry*, 6.

³⁴³ Potato Growers of Alberta, *Alberta Processed Potatoes*.

vegetables.”³⁴⁴ Given Alberta’s strengths in pulse production, identifying ways of developing new pulse-based snacks (potentially a healthier alternative to potato-based snacks) could be an area of opportunity for Alberta businesses. Indeed, efforts have already been made by Alberta researchers, through the Leduc Food Processing Development Centre, to explore these opportunities (see section above on “Ingredients and Value-Adding Opportunities”). Other Alberta commodities which could find application in snack foods include cereals, seeds and nuts, and oils.³⁴⁵

Chart 20
Alberta exports of processed potato products (\$ millions)



Source: Alberta and Agriculture and Rural Development; The Conference Board of Canada.

Confectionary Market Opportunities

Alongside salty and savoury snacks, the global confectionary market is one in which “Canadian confectionary manufacturers could see gains through the strength of their innovation, by striking strategic partnerships with competitors, or by engaging in merging or acquisition activity of their own.”³⁴⁶ The United States will remain the largest market (\$38.8 billion), followed by the United Kingdom (\$13 billion), Russia (\$13.5 billion), and Germany (\$13.4 billion) until at least 2014.³⁴⁷ However, emerging markets represent the greater share of market growth. Confectionary sales in the Ukraine are forecast to grow by 65 per cent by 2014 (compared to 2011 figures), followed by China (38 per cent), Russia (33 per cent), and Brazil (28 per cent).³⁴⁸

In 2009, Canada ranked 7th in global market share for confectionery exports, for a total of \$1.5 billion in shipments.³⁴⁹ Alberta industry activity in the confectionery sector, however, does not appear to be significant, despite some export growth among its two key foreign markets. The

³⁴⁴ Agriculture and Agri-Food Canada, *The Canadian Snack Food Manufacturing Industry*, 11.

³⁴⁵ Agriculture and Agri-Food Canada, *The Canadian Snack Food Manufacturing Industry*, 3.

³⁴⁶ Agriculture and Agri-Food Canada, *Global Packaged Confectionary Trends*, 8.

³⁴⁷ Agriculture and Agri-Food Canada, *Global Packaged Confectionary Trends*, 6.

³⁴⁸ Agriculture and Agri-Food Canada, *Global Packaged Confectionary Trends*, 4.

³⁴⁹ Agriculture and Agri-Food Canada, *Global Packaged Confectionary Trends*, 8.

province’s exports of sugar and sugar preparations to the United States grew from \$7.6 million in 2003 to an estimated \$34.2 million in 2012.³⁵⁰ Exports to Mexico have also grown considerably, from \$237 thousand to approximately \$12 million in 2012.³⁵¹ The only other foreign buyer of Alberta’s sugar and sugar preparation products is Japan, and total sales have remained negligible over the past decade—peaking at a mere \$56 thousand in 2008.³⁵²

Although Alberta begins from a place of weaker capacity, this does not mean that opportunities in the confectionery sector are not available for innovating food businesses and entrepreneurs. Increasingly, health-conscious consumers—particularly those in the United States, the United Kingdom, and Japan—will be interested in confectionary products that offer improved nutritional characteristics (including reduced calories and sugar content).³⁵³ Alberta can already boast of some success in this area: Edmonton-based BioNeutra, for example, has developed a low-calorie sweetener using starch from Alberta cereal crops (including wheat, barley, and potatoes), and the product is currently in use by US manufacturers of chocolates bars, beverages, candy and cookies, and yogurt.³⁵⁴

VII. Beverages

The beverage industry produces a diverse array of non-alcoholic and alcoholic drinks. The non-alcoholic beverage industry includes juices, fruit drinks, carbonated soft drinks, tea, coffee, and bottled water. In 2009, coffee was the most popular non-alcoholic beverage in Canada with a market share of 16.6 per cent, followed by carbonated soft drinks (16.3 per cent), tea (12.9 per cent), milk (12.7 per cent), and bottled water (10.6 per cent).³⁵⁵ The alcoholic beverage industry includes beverages (e.g. beer, wine, spirits) that contain more than 1.1 per cent alcohol by volume.³⁵⁶ In 2012, beer was the most popular alcoholic beverage in Canada with a market share of 44 per cent, followed by wine (31 per cent), and spirits (25 per cent).³⁵⁷

Market Trends

Non-Alcoholic Beverages

Trends in the beverage industry are similar to those in the food industry as a whole. The trend in the food industry towards functional foods, which offer physiological benefits or reduce the risks of chronic disease, has also been a major trend in the non-alcoholic beverage industry. Functional beverages include energy drinks (beverages that contain caffeine and other energy enhancing ingredients such as herbal extracts and vitamin B), sports drinks (designed to be consumed in conjunction with exercise to prevent dehydration and supply carbohydrates and electrolytes, and do not contain caffeine), and nutraceutical drinks (designed to promote and enhance health through ingredients such as concentrated extracts from teas, fruits, vegetables and herbs).³⁵⁸

³⁵⁰ Government of Alberta, *Highlights on Alberta Agri-Food Exports in 2012*, 6.

³⁵¹ Government of Alberta, *Highlights on Alberta Agri-Food Exports in 2012*, 9.

³⁵² Government of Alberta, *Highlights on Alberta Agri-Food Exports in 2012*, 8.

³⁵³ Agriculture and Agri-Food Canada, *Global Packaged Confectionary Trends*, 2.

³⁵⁴ Interview with Dr. Jianhua Zhu (BioNeutra). Telephone interview by Erin Butler.

³⁵⁵ Agriculture and Agri-Food Canada, *The Canadian Soft Drink Industry*.

³⁵⁶ Standing Committee on Agriculture and Agri-Food, *Toward a Common Goal: Canada’s Food Supply Chain-Part 1*.

³⁵⁷ Standing Committee on Agriculture and Agri-Food, *Toward a Common Goal: Canada’s Food Supply Chain-Part 1*.

³⁵⁸ Deloitte, “Functional Beverages,” 10.

There is a considerable market for functional beverages in North America. The functional beverage market in the U.S. was estimated to be over USD \$6.9 billion in 2011.³⁵⁹ Energy drinks have by far the largest share (63 per cent) of the functional drink market in the U.S., followed by sports drinks (27 per cent), and nutraceutical beverages (10 per cent).³⁶⁰ Sales of functional beverages are expected to continue to grow in the U.S. in Canada. The market for functional beverages is highly competitive, with numerous new and established competitors. New products are constantly being introduced and established companies continue to diversify the range of functional beverages they offer.³⁶¹

The beverage industry is also seeing a trend towards “better for you” beverages or “natural beverages.”³⁶² This includes beverages with reduced or no added sugar, zero or low calories, and reduced or no artificial flavours and colours. Beverages that use zero-calorie, “natural” sweeteners, such as stevia or agave, are increasingly prominent in the market.³⁶³ Stevia, a natural zero-calorie sweetener derived from the stevia plant is a relatively recent food innovation, having only been approved for the use in the U.S. in 2008, Europe in late 2011, and Canada in late 2012.³⁶⁴ There is significant interest in the beverage industry in the development of other types of natural, low or no calorie sweeteners.³⁶⁵

Trends towards healthier and functional beverages are fuelling growth in several key product segments. There is growing demand for flavoured or sparkling waters which have low or no calories, as well as fortified and functional waters.³⁶⁶ In the U.S., the market for sparkling/mineral water grew by 34 per cent between 2011 and 2012.³⁶⁷ Similarly, much of the recent growth in the sports drink market in the U.S. has been fuelled by diet sports drinks.³⁶⁸ Many juice products are also seeing increased popularity, including those with reduced or no-sugar (including those using stevia and agave) and functional juices (such as those high in vitamins or incorporating superfruits, such as pomegranates), which are seen as having special health benefits.³⁶⁹ Fruit smoothies have also increased in popularity in North America as a “healthy” snack or breakfast option.³⁷⁰

Sales of tea products continue to grow worldwide, and green, red and white teas are becoming increasingly popular, as are organic teas. The increasing popularity of tea is due to its perceived health benefits and “natural” attributes. Unsweetened tea beverages, including chilled drinks, are also becoming more popular because of their lack of calories. There is a trend towards premium teas, with consumers willing to pay more for ready to drink and high quality products.³⁷¹

³⁵⁹ Deloitte, “Functional Beverages,” 10.

³⁶⁰ Deloitte, “Functional Beverages,” 10.

³⁶¹ Deloitte, “Functional Beverages,” 11.

³⁶² See above for explanations of “better for you” and “natural beverages.”

³⁶³ Agriculture and Agri-Food Canada, *Consumer Trends*, 6.

³⁶⁴ Phillips, “Beverage Trends.”

³⁶⁵ Phillips, “Beverage Trends.”

³⁶⁶ Agriculture and Agri-Food Canada, *Consumer Trends*, 4; Beverage Industry, “2013 State of the Industry.”

³⁶⁷ Beverage Industry, “2013 State of the Industry.”

³⁶⁸ Beverage Industry, “2013 State of the Industry.”

³⁶⁹ Agriculture and Agri-Food Canada, *Consumer Trends*, 4; Beverage Industry, “2013 State of the Industry.”

³⁷⁰ Strachan, “Hot Trends in Non-Alcoholic Beverages.”

³⁷¹ Beverage Industry, “2013 State of the Industry: Tea and RTD Tea.”

Alcoholic Beverages

In Canada, the market share of beer continues to decline as wine increases in popularity. However, in 2011-2012, Alberta reported the largest increase in beer sales in Canada (7.1 per cent).³⁷² In Alberta and other developed markets, there is a growing interest in craft beer, including locally produced products.³⁷³ However, while there is strong demand for craft beer, consumer demand for “healthier” and low calorie products pose a challenge to the brewing industry.³⁷⁴

Alberta Capacity

Alberta has a small beverage industry. In 2008, beverage manufacturing accounted for 6.6 per cent (\$776.8 million) of the province’s food and beverage manufacturing activity.³⁷⁵ Major producers, such as Coca-Cola and Cott, have production facilities in Alberta, but their R&D activities generally take place outside the province.³⁷⁶

Non-Alcoholic Beverages

There is some potential for the Alberta beverage industry to focus on functional beverages. As noted above, Alberta has some of the most promising research and innovation on functional foods in Canada, and there is a significant number of companies in Alberta that focus on functional foods and natural health products. While many of these activities are not explicitly focussed on beverages, they could also benefit the provincial beverage industry.

From the Earth Naturally is an Alberta company that sells VIVACA, a natural health supplemental beverage to help diminish the symptoms of menopause. The product is currently for sale online in the U.S., and will soon be available online in Canada. From the Earth Naturally has faced challenges scaling up its production in Alberta, due to a lack of local production capacity. Many of the company’s production operations currently take place outside of the province.³⁷⁷

Alberta also has several examples of beverage companies who are capitalizing on the trend for naturally healthy beverages:

- *Dehnamar Inc* is a small Edmonton company that sells an all natural beverage, Honey Spice, which uses Alberta honey as one of its ingredients.
- Edmonton-based *VitalyTeas Ltd* is a small, premium tea and chai concentrate manufacturer that uses local herbs and only natural, organic ingredients. The company promotes the health benefits associated with tea.

³⁷² Statistics Canada, “Control and Sale of Alcoholic Beverages.”

³⁷³ Agriculture and Agri-Food Canada, *The Canadian Brewery Industry*; Beverage Industry, “2013 State of the Industry: Beer.”

³⁷⁴ Agriculture and Agri-Food Canada, *The Canadian Brewery Industry*.

³⁷⁵ Alberta Agriculture and Rural Development, “Food and Beverage Industries.”

³⁷⁶ Interview findings.

³⁷⁷ Interview findings.

- Headquartered in Edmonton, *Booster Juice* is Canada’s largest chain of juice and smoothie stores, and has locations in six countries. The company’s menu includes natural ingredients with nutritional and health benefits, such as echinacea, ginseng and wheatgrass.

However, as stated above, Alberta has limited research activities focused on naturally healthy products. Much of the industry and research capacity in these areas tends to be focused on the meat industry, and would likely have limited applicability to the beverage industry. Research into the nutritional and health benefits of fruits and other plant-based ingredients, including alternative sweeteners, could be of benefit to the beverage industry.

Alcoholic Beverages

Alberta has two large malting companies that supply malting barley for the production of beer and spirits. *Canada Malting Company*, the largest malt company in Canada, is headquartered in Calgary. The success of these companies has been fuelled in part by barley production in the province. While private industry has been actively involved in plant genetics in other areas, and there are some research programs which focus on barely (as noted above), the barley genome is reportedly more difficult to work with than some other plant species. Thus, although barley research is a focus of many Alberta researchers and findings could enhance the quality of malting barley grown in Alberta, the complexity of the research may prove challenging. At the same time, international competitors—such as Australia—are providing significant public funding for barley research activities.³⁷⁸

There is potential for Alberta’s brewing industry. Craft breweries in the province are continually innovating with new types of beer. Calgary’s *Big Rock Brewery* is Canada’s largest craft brewery, with products sold across Canada and in Korea. Other small-scale craft brewers, such as *Wild Rose Brewery* and *The Yellowhead Brewing Company*, are also having success in local markets.

However, the number of micro breweries in Alberta lags behind that of other provinces—for example, in 2010 British Columbia had 34 microbreweries, while Alberta had nine.³⁷⁹ Craft brewers in Alberta are largely limited to the provincial market and have limited opportunities for export due to high competition and restrictions that make it difficult to transport beer across provincial boundaries. In 2011, beer exports from Alberta were valued at only \$1.2 million, while in 2012 they were so small that Statistics Canada deemed the amount negligible.³⁸⁰

VIII. Packaging

Research and innovation in food packaging has been an important part of food innovation generally given the benefits it can offer in terms of safety, shelf life, waste reduction, convenience, and marketing. Food businesses are constantly looking for new and better ways to package their products to enhance consumer and business value. The challenge for many is to incorporate a change in packaging that promises improvements in one area—such as waste reduction—without compromising other critical attributes—such as safety.

³⁷⁸ Interview findings.

³⁷⁹ Foster, “The Bruising Business of Brewing in Alberta.”

³⁸⁰ Government of Alberta, *Agri-Food Exports: Alberta 2003-2012*.

Nano Packaging

Developments in nanoscience have promising applications in food packaging, particularly with respect to safety. In many cases, while packaging innovations using nanomaterials have been researched and developed in labs and other research centres, application in consumer packaging has lagged. This is due in part to business and consumer concerns about the still unclear health and environmental effects of nanomaterials. But the situation is changing rapidly as evidence about effects is accumulating. Some prominent developments include the following:

- Silver nanoparticles have enhanced antibacterial properties owing to their large surface to volume ratios and, as such, are being incorporated into food packaging to reduce pathogen development and extend the shelf lives of certain foods. Additionally, silver nano linings are being incorporated into food preparation and storage surfaces to reduce bacterial development.³⁸¹
- Nanoparticle films are being developed by researchers at the University of Connecticut which, when incorporated into packaging, are able to detect pathogens and alert consumers to their presence through changes in the package colour.³⁸²
- Nanotech “bioswitches” have the potential to trigger the release of preservatives if food is at risk of spoiling.³⁸³

Although none of these are examples of research being carried out in Alberta, given Alberta’s nanotechnology capacity there is a foundation to investigate and develop these and similar nano-based packaging technologies. Additionally, because consumer acceptance will depend on the results and communication of health and environmental risk assessments, nanotechnology researchers in Alberta may be well-positioned to contribute.

Biodegradable Packaging

Motivated by a concern to reduce the environmental impact of food packaging, some businesses are exploring developments in biodegradable packaging. Researchers in many jurisdictions are exploring the potential for certain materials to biodegrade, but which would not adversely affect food safety (for example, by degrading prematurely and exposing food to air and other elements) or quality (for example, by leaching into foods). Although some interviewees noted that biodegradable packaging is in demand by some Alberta food businesses, there was no mention of any research or innovation in this area among Alberta researchers or businesses.

There are a few researchers in Alberta who investigate the biodegradable properties and potential of polymers, including a researcher in the Department of Agriculture, Food, and Nutritional Science at the University of Alberta who looks at polymers and nano-structured biomaterials for, among other things, biodegradable packaging.³⁸⁴ However, applications in food packaging specifically do not appear to be a primary focus.

³⁸¹ N. Mahalik and A. Nambiar, “Trends in food packaging,” 119; P. Titoria and K. Groves, “Nanotechnology for the food industry.”

³⁸² N. P. Mahalik and A.N. Nambiar, “Trends in food packaging,” 119.

³⁸³ N. P. Mahalik and A.N. Nambiar, “Trends in food packaging,” 119.

³⁸⁴ Aman Ullah, Assistant Professor, University of Alberta. www.afns.ualberta.ca/staffprofiles/academicprofiles/ullah.aspx.

One of the challenges with packaging innovation noted by a business operating nationally is that the regulatory regime for packaging is fragmented. There are different standards and requirements across provinces and municipalities which make it very difficult to introduce packaging changes. The costs of customizing packaging to comply with individual jurisdictions’ regulatory requirements are prohibitive. An executive with a large, national food and beverage company observed that “as a national company that aims to sell across the country, this fragmentation slows us down quite a bit.”³⁸⁵ Indeed, he noted that more resources devoted to navigating the fragmented regulatory landscape means fewer resources available for research and innovation at the company.

Conclusion

As this chapter reveals, there are many research and innovation opportunities that align with market trends and provincial research and industry capacity in which Alberta Innovates Bio Solutions could invest. Areas that emerge as strong candidates for further assessment include ingredients and value-adding opportunities; functional foods, nutraceuticals, and fortification; and food safety. Other areas worth considering include food biotechnology, food nanotechnology, potato- and pulse-based snacks, and special dietary needs. The next chapter identifies a subset of the most promising opportunities and subjects them to a further portfolio analysis—including economic and social impact analyses—in order to develop investment recommendations for Alberta Innovates.

³⁸⁵ Confidential interview with industry executive. Interview by Daniel Munro. February 26, 2013.

Chapter 5

Opportunity Analysis

Chapter Summary

- Using criteria that reflect Alberta Innovates Bio Solutions’ economic and social objectives, as well as the requirements of innovation success, we identify and rate a subset of relevant research and innovation opportunities.
- Research and innovation investments in ingredients and value-adding opportunities in livestock and crops; certain functional foods, nutraceuticals, and fortification areas; and meat safety show the greatest potential given market alignment, and research and industry capacity.
- Opportunities in biotechnology (particularly genomics), poultry bioactives, choline, and food nanotechnology are also promising, although each faces a challenge in research capacity, industry capacity, or market alignment.
- Opportunities in special dietary needs (e.g., gluten-, dairy-, and nut-free products), and potato- and pulse-based snack foods, have industry capacity and market demand, but the state of research in these areas requires further investigation to determine whether it is weak, but needed, or not needed at all.

Alberta Innovates Bio Solutions has a wide range of research and innovation opportunities in which it could invest. From the perspective of advancing knowledge, investments in nearly all of the areas discussed in the previous chapter would very likely produce results. But if the point of the investments is ultimately to achieve specific economic and social objectives, then the opportunities should be considered through suitable economic and social analytical lenses. The present chapter presents the method and results of these analyses.

Finding the Sweet Spot

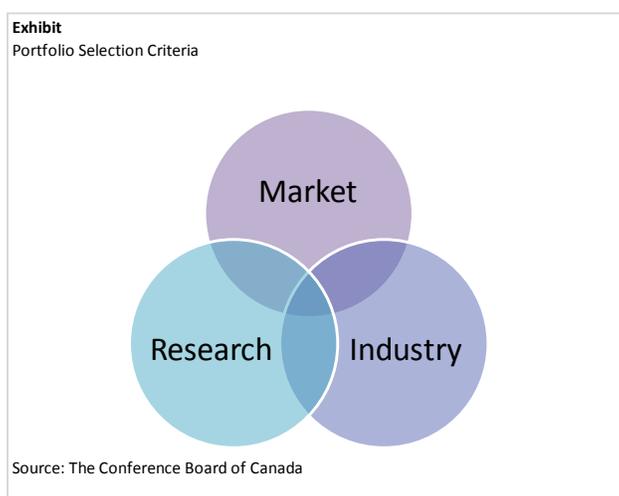
Alberta Innovates Bio Solutions clearly seeks to improve the competitive capabilities of current and new Albertan industries. The rationale for government support for this strategy is based on a perceived underinvestment in food innovation projects.³⁸⁶ This underinvestment may result from perception of excessive risk by commercial funders. This perception may see investment funds flow to incumbent firms outside of Alberta (e.g. Ontario based food companies). We have noted that Alberta food companies do not invest heavily in research and development. Most of the food manufacturing capacity exists in central Canada and it is there that most of food research and development takes place. So there is a policy rationale for Alberta Innovates Bio Solutions to fill this gap.

What should drive its approach? We believe that there are three considerations:

³⁸⁶ See Cranfield and others, *Financing Innovation in Functional Food*.

1. *Alberta’s industrial capacity.* This is important for two reasons. First, it increases the chance of research investments paying dividends in terms of industrial value added. Second, it reduces the risks of start-up innovations, which are the most risky innovations.
2. *Alberta’s research capacity.* As Alberta Innovates Bio Solutions focuses on the research part of the value chain, it is important that it focuses on areas where there are existing research capabilities. This also improves the odds of success and value creation within the province.
3. *Market demand.* In the final analysis, innovation payoff depends on adoption. This is why we emphasize the importance of commercialization in this report. Although Alberta Innovates Bio Solutions may be involved in different stages of the innovation process, it is extremely important that it supports innovations that have a growing market.

The sweet spot for support is at the intersection of these three factors.



Assessment Criteria and Ratings

To select a relevant and promising subset of investment options that land in this sweet spot, the Conference Board developed a set of more precise assessment criteria and then rated each opportunity. Based on the information collected through literature, data sources, and interviews—as described and analyzed in the previous chapter—many possibilities were ruled out and a subset of more realistic and relevant opportunity categories and areas were identified. This subset—which constitutes the set subjected to further analysis in this chapter—is characterized in the textbox below.

The specific criteria against which we assessed these opportunities are presented in Table 3 below. Three Conference Board analysts individually and independently reviewed the information provided in Chapters 1 through 4 of the report and made a judgment about each opportunity based on the criteria outlined in Table 3. In most cases the judgments of the three analysts were in agreement. In the few instances where there was disagreement, the analysts deliberated and reached a conclusion about the most appropriate judgment. Table 4 presents the results of this exercise.

Key Research and Innovation Opportunities For Further Analysis

I. Platform Technologies

- *Nanotechnology*
 - packaging and testing
 - nanoencapsulation
- *Food Biotechnology*
 - Genomics
 - Crop/livestock production
 - Food safety applications
 - Traceability/quality assurance
- *Other Technologies*
 - Plant lipid biotech
 - Supercritical fluid technologies
 - Dairy processing technologies

II. Health Food Innovation

- *Reformulation*
 - sodium reduction/replacement, peptides
 - preservative reduction/replacement
 - harmful fats reduction
 - increased fibre content
- *Naturally Healthy*
 - meat/poultry “free-from” additives or inputs (e.g., hormones, antibiotics)
 - “free-range” production practices
 - organic
- *Special Dietary Needs*
 - gluten-free
 - nut-free
 - dairy-free

III. Functional Foods, Fortification, and Nutraceuticals

- *Omega-3 Enhanced Products*
- *Barley/Beta-Glucan*
- *Functional Pulse-Based Ingredients*
- *Dairy Proteins*
- *Poultry bioactives*
- *Choline*
- *Dietary Supplements*

IV. Food Safety

- *Rapid diagnostic technologies*
- *Food safety additives*
- *Challenge studies*
- *High-pressure processing*
- *Irradiation*
- *Meat safety*

V. Ingredients and Value-Adding Opportunities

- *Livestock and beef* (e.g., bioactives from meat; functional ingredients from poultry; fatty-acid composition of beef)
- *Cash Crops* (bioactives in cereals; bioactives in oilseeds; pulse fractionation)
- *Dairy* (bioactives from cow’s milk; dairy proteins).

VI. Indulgence/Snack Foods

- *Potato-based snacks*
- *Pulse-based snacks*

VII. Beverages

- *Functional beverages*
- *Naturally healthy beverages*
- *Malt-based alcoholic beverages*

VIII. Packaging

- *nano-packaging*
- *biodegradable packaging*

Table 3
Opportunity Assessment Criteria, Questions, and Rating Scale

Criteria	Key Questions	Scale
Market Alignment	<ul style="list-style-type: none"> How well does the opportunity align with domestic and global trends in consumer demand? Is the trend long-term (e.g., driven by demographics) or short-term (e.g., food fads)? 	1 – no alignment 2 – weak alignment 3 – somewhat weak alignment 4 – moderate alignment 5 – moderately strong alignment 6 – strong alignment 7 – extremely strong alignment
Research Capacity	<ul style="list-style-type: none"> Can the opportunity be seized given the existing strengths and capacity of Alberta’s food sector research community? Does Alberta have research <i>expertise</i> in this area? Does Alberta have research <i>facilities</i> in this area? Is there robust or sporadic research activity in this area? 	1 – no capacity 2 – weak capacity 3 – somewhat weak capacity 4 – moderate capacity 5 – moderately strong capacity 6 – strong capacity 7 – global leader
Industry Capacity	<ul style="list-style-type: none"> Can the opportunity be seized given the existing strengths and capacity of Alberta’s food sector business community? Are there many and/or large businesses with strong receptor capacity in this area? Are they developing or selling products in this area? Are Alberta businesses <i>interested</i> in this area? 	1 – no capacity 2 – weak capacity 3 – somewhat weak capacity 4 – moderate capacity 5 – moderately strong capacity 6 – strong capacity 7 – global leader
Anticipated Social Impact	<ul style="list-style-type: none"> Would products/processes based on this research improve population health outcomes? Would products/processes based on this research improve environmental performance? 	1 – no impact 2 – weak impact 3 – somewhat weak impact 4 – moderate impact 5 – moderately strong impact 6 – strong impact 7 – extremely strong impact

Source: The Conference Board of Canada

In addition, the research and analysis uncovered an industry need for what we call “regulation science”—that is Canadian-generated science that is required by Health Canada as part of the health claims process. Although interviews revealed that few researchers are interested in this area, it is a foundational need to which Alberta’s researchers could contribute and would provide commercial value for industry. The research also revealed the need for research related to the health and environmental effects of various technologies, consumer receptivity to emerging technologies, and the determinants of dietary patterns and consumer behaviour. Because these categories of research opportunities do not lend themselves to the same kind of assessment, we exclude from the analysis, but nevertheless note them so decision-makers are aware of their importance.

Table 4
Evaluation of Opportunities

Opportunity	Market Alignment	Alberta Research Capacity	Alberta Industry Capacity
I. Platform Technologies			
Nanotechnology			
Packaging and Testing	5	6	2
Nanoencapsulation	5	6	2
Food Biotechnology			
Applications in crop and livestock production	6	6	4
Food safety applications	6	6	4
Traceability and quality assurance	5	6	4
Other Technologies			
Plant Lipid Biotech	4	5	1
Supercritical Fluid technologies	4	4	1
Dairy Processing Technologies	4	5	5
II. Healthy Food Innovation			
Reformulation			
sodium reduction/replacement; peptides	6	4	4
preservative reduction/replacement	6	4	4
harmful fats reduction	6	4	3
increased fibre content	6	3	3
Naturally Healthy			
Meat/poultry “free-from” additives/inputs (e.g., hormones, antibiotics).	5	5	4
“free-range” production practices	5	1	4
organic	5	1	4
Special Dietary Needs			
gluten-free	6	1	5
nut-free	6	1	4
dairy-free	6	1	4
III. Functional Foods, Fortification, and Nutraceuticals			
Omega-3 Enhanced Products	6	4	4
Barley/Beta-Glucan	4	6	6
Functional Pulse-Based Ingredients	4	6	6
Dairy Proteins	6	6	5
Poultry bioactives	3	6	5
Choline	3	6	5
Dietary Supplements	6	1	3
IV. Food Safety			
Rapid diagnostic technologies	5	6	4

Opportunity	Market Alignment	Alberta Research Capacity	Alberta Industry Capacity
Food safety additives (e.g., lactic-acid sprays)	4	6	4
high-pressure processing	5	5	4
irradiation	4	1	4
Meat safety (e.g., prion disease research)	6	6	6
V. Ingredients and Value-Adding Opportunities			
Livestock/beef (e.g., meat-derived bioactives; functional poultry waste ingredients)	5	6	7
Cash Crops (e.g., bioactives in cereals; bioactives in oilseeds; pulse fractionation)	6	7	7
Dairy (e.g., bioactives from cow’s milk; dairy proteins)	5	5	5
VI. Indulgence/Snack Foods			
potato-based snacks (potato chips, french fry manufacturing)	7	1	6
pulse-based snacks	5	4	6
VII. Beverages			
functional beverages	5	5	3
naturally healthy beverages	5	N/A	3
malt-based alcoholic beverages	5	N/A	3
VIII. Packaging			
Nano-packaging	2	3	2
Biodegradable packaging	3	3	2

Source: The Conference Board of Canada

We highlight the different strategies in the table. Areas with strong existing alignment are highlighted in green. Weaker, but still promising, areas of alignment are highlighted in yellow. Purple highlighting indicates areas where there are strong research capabilities and market demand, but where start-ups would need to be created to commercially exploit opportunities. Finally, blue highlighting indicates a possible area for investment but the data are unclear about existing research capacity.

The strongest alignment (i.e., green highlighting) occurs in three areas:

- Certain areas of *ingredients and value-adding opportunities* show great promise—particularly where they overlap with Alberta’s livestock and crop sectors. In these areas, strong research capacity is complemented by exceptionally strong industry capacity as both supplier of raw ingredients and value-added products. Moreover, global market demand for these kinds of products is rising which suggests that the opportunities are growing. So long as bridges between the research and industry communities can be built and maintained, there is reason to believe that this could be a very significant source of economic value for Alberta’s food sector.

- Certain kinds of *functional foods, nutraceuticals, and fortification* initiatives are also promising, particularly in the areas of barley/beta-glucan, functional pulse-based ingredients, and dairy protein. Here we find a high degree of alignment between market demand, research capability, and industry capability. Note that in Chapter 4 we observed that the functional food industry in Alberta may be struggling; however, given the sheer size of the number of companies involved and the opportunities they face, we regard industry capacity as strong overall.
- The third area of stand-out strength—i.e., where research and industry capacity align and there is market demand—is in the area of *meat safety*. This is of huge importance to the Alberta and Canadian agri-food industry. Failures in meat safety have a massive impact on Alberta because it is a specialization of the agri-food economy.

Although not as strong as the previous three, there is good reason for Alberta Bio Innovates to consider research investments in others areas of emerging or potential strength and alignment (i.e., yellow highlighting):

- The research capacity in biotechnology—particularly, *genomics*—and the potential for commercial applications are strong. Biotech applications in crop and livestock production, food safety, and traceability and quality assurance stand out. Although the industry capacity to develop and implement applications is less than ideal, it is not entirely absent. With sufficient support, this could be an area of emerging strength for the Alberta food sector.
- Two other kinds of functional food, fortification, and nutraceuticals applications also fall in this category—namely, *poultry bioactives* and *choline*. In this case, there is strong research capacity and some industry capacity, but less apparent evidence for market demand. In this case, a good strategy may be follow the lead of the industry players as they determine whether pursuing these areas makes sense from a market demand point of view.

The section highlighted in purple indicates an opportunity with an outstanding challenge:

- *Food nanotechnology* may have a role to play in food innovation in the province. Although there is very little in terms of industry capacity in Alberta, the very strong research capacity is an opportunity ripe for development. Alberta would benefit, in our view, from entrepreneurial endeavours spun off from its research capabilities in nanotechnologies. In Ontario, Waterloo has nurtured a cluster of firms spun off from the University of Waterloo’s strengths in computer technology. In the 1980s there was no industrial capacity to support new technologies that formed the basis of companies like Blackberry and Open Text Corporation. Sometimes industrial capabilities need to be formed out of the research community as existing industry is tied to old products and processes.

Finally, the rows highlighted in blue indicate that there is industry capacity and market opportunity, but that the research capacity is weak or unknown. Two types of food innovations fall in this category:

- Alberta has both extraordinary market opportunity and industry capacity in *potato and pulse-based snack foods*. What is unclear is the extent to which research capacity is available to support growth or, for that matter, whether non-industry research capacity is required. We flag this as an area Alberta Innovates Bio Solutions should investigate further. There may be

unmet research needs which would find quick adoption by industry and achieve market success. Again, the best approach may be to consult with industry to determine their research needs in this area.

- Alberta appears to have good market opportunity and industry capacity in *special dietary needs* products, but the available evidence does not allow us to assess the state of research capacity, or whether much research is in fact required by industry. It may be that there are no researchers in Alberta working in this area, or that there are some but were not identified by our research. This is an area that Alberta Innovates Bio Solutions may want to investigate further.

Social Impact Analysis

Opportunities with the greatest potential innovation and economic impact may not be the same as those with the greatest social—primarily, health—impact. Thus, we supplement the portfolio and economic analysis with a social impact analysis.

As we note earlier in the report, the health impact of research and innovation investments is complicated by multiple intervening variables. Dietary patterns are shaped by a wide range of factors including consumer awareness, motivation, preferences, and resources; access; advertising; social and demographic factors; and characteristics of the food supply.³⁸⁷ Given that food research and innovation investments which could lead to new products or processes will only affect the food supply factor, the potential for significant health improvements is minimal. Only in cases where an entire class of products—such as all processed foods containing sodium—are substantially improved will there be any measurable effect on health outcomes.

For this reason we recommend investments not only in product and process innovation, but also in research focused on consumer behaviour and the determinants of dietary patterns. These investments could be considered by the Alberta Innovates group. Indeed, *Alberta’s Food and Health Innovation Framework* is correct in identifying a “complex behavioural challenge” that must be overcome before health improvements can be achieved by improving the quality of the food supply. “The biggest challenge to creating long-term change,” according to the *Framework*, “is changing individual behaviour through education and fostering motivation to make healthier choices.”³⁸⁸

Yet, incremental improvements are possible even with a supply-side focus. Logically, a product with less sodium which replaces a product with more sodium in an individual’s diet constitutes an improvement. And a critical mass of such products—i.e., a fundamental shift in the food supply—should produce more substantial improvements. Using the questions and scale outlined earlier in the chapter, and drawing from research conducted in this project and previous Conference Board work, we analyzed the subset of opportunities for their potential social

³⁸⁷ The following sections draw in part from Conference Board, *Improving Health Outcomes*. A useful conceptual framework can be found in K. Raines, “Determinants of Healthy Eating in Canada.”

³⁸⁸ Alberta Life Sciences Institute, *Making the Food-Health Connection*, iii.

impact.³⁸⁹ The results appear in Table 5. (See Table 3 above for explanation of assessment criteria and scale).

In general, the potential health impacts are of two kinds—reduced risk of chronic diseases and reduced risk of acute illness. As noted in the table, some innovations (particular those focused on reformulation or fortification) may reduce the risk and prevalence of chronic diseases such as cardiovascular diseases, some cancers, and diabetes. Other innovations, such as those related to food safety, have the potential to reduce acute health risks—i.e., food borne illness. Another class of innovations—namely those focused on certain special dietary needs (such as gluten-free, dairy-free, and nut-free products—can reduce other acute risks associated with food allergies. Finally, there are innovations related to packaging, nanotechnology, and biotechnology, which could reduce harmful environmental impacts of food production and consumption.

As the table shows, most research and innovation opportunities have the potential for only moderate social impacts. These are highlighted in yellow. Such impacts can only be achieved where research, industry uptake, and consumer behaviour are aligned. A small subset of opportunities—highlighted in green—has potential for moderate to strong social impacts. Where opportunities are not highlighted this indicates either minimal potential impact or, in some cases, that the evidence for potential impacts is disputed.

Note: We have included only those opportunities that received some kind of colour grading in the economic analysis above.

³⁸⁹ In addition to new literature and data collected for this project (referenced in discussions of research opportunities in Chapter 4), evaluations of social impact draw from various Conference Board Centre for Food in Canada reports, including *Improving Health Outcomes* (Chapter 2 – Dietary Factors and Chronic Disease: A Risk Assessment); *Improving Food Safety in Canada*; *Competing for the Bronze*; and *Reducing the Risk: Addressing the Environmental Impacts of the Food System*.

Table 5
Potential Social Impact of Research and Innovation Opportunities³⁹⁰

Opportunity	Social Impact	Details
Nanotechnology		
Packaging and Testing	4	Potential for moderate reductions food-borne illness due to improved shelf life and ability of consumers to identify/avoid spoiled food.
Nanoencapsulation	4	Potential for moderate health benefits due to more efficient delivery of nutrients during consumption.
Food Biotechnology		
Crop/livestock applications	4	Wide range of potential weak to moderate health and environmental benefits depending on focus.
Food safety applications	6	Strong likelihood of reduction in acute health impacts due to better detection and reduction of food borne illness risks.
Traceability/quality	4	Some contribution to reduction of food borne illness risks due to improved traceability.
Reformulation		
Sodium replacement	5	Potential for moderate to strong reductions in cardiovascular disease rates, and possibly certain cancers, depending on consumption patterns.
Preservatives reduction	2	Disputed health benefits.
Special Dietary Needs		
Gluten, nut, dairy free	6	Significant reduction in acute health risks for consumers with various food allergies and intolerances.
Functional Foods, Fortification, and Nutraceuticals		
Barley/Beta-Glucan	4	Potential for moderate health benefits due to increased consumption of nutrients.
Functional Pulse-Based Ingredients	4	Potential for moderate health benefits due to increased consumption of nutrients.
Dairy Proteins	4	Potential for moderate health benefits due to increased consumption of nutrients.
Poultry bioactives	4	Potential for moderate health benefits due to increased consumption of nutrients.
Choline	4	Potential for moderate health benefits due to increased consumption of nutrients.
Food Safety		
Rapid diagnostic technologies	6	Strong likelihood of reduction in acute health impacts due to better detection and reduction of food borne illness risks.
Meat Safety	6	Strong improvements to population health via reduced acute food safety risk depending on adoption of insights into industry practice.
Ingredients and Value-Adding Opportunities		
Livestock/beef	4	Potential for moderate health benefits due to increased consumption of nutrients.
Cash crops	4	Potential for moderate health benefits due to increased consumption of nutrients.
Dairy	4	Potential for moderate health benefits due to increased consumption of nutrients.
Indulgence/Snack Foods		
Potato-based snacks	1	No health benefit.
Pulse-based snacks	2	Unclear health benefit.

³⁹⁰ In addition to new literature and data collected for this project (referenced in Chapter 4), evaluations of social impact draw from various Centre for Food in Canada reports, including *Improving Health Outcomes* (Chapter 2 – Dietary Factors and Chronic Disease); *Improving Food Safety in Canada*; *Competing for the Bronze*; and *Reducing the Risk: Addressing the Environmental Impacts of the Food System*.

Conclusion

As these analyses show, there are a variety of research and innovation opportunities for Alberta Innovates Bio Solutions to consider. In some cases, the alignment between research and industry capacity, and market demand, is strong—such as in ingredients and value-adding opportunities, certain functional foods, nutraceuticals, and fortification opportunities; and meat safety. In other cases, an opportunity may score poorly on one of the assessment criteria but well on the other two, thereby creating categories of opportunities with outstanding challenges—i.e., build industry capacity to meet research strength and market demand; build research capacity to meet industry and market demand; or determine whether there is a market for already strong research and industry capacity in a given area.

With only a few exceptions, the expected social—i.e., health or environmental—benefits of research and innovation in the candidate areas are moderate to low, owing primarily to the fact that food-related health outcomes are generally determined by long-term dietary patterns and not individual products. The exceptions are where food innovations can reduce acute health risks, such as those arising from food allergies and pathogens that can lead to food-borne illnesses.

Chapter 6

Lessons from International Initiatives

Chapter Summary

- Major initiatives in other jurisdictions provide strategic lessons for Alberta as it pursues food research and innovation.
- Analysis of the Netherlands’ Food Valley, Australia’s Food and Health Dialogue, and Scotland’s Food and Health Innovation Service reveal the importance of multi-stakeholder support and collaboration to food innovation success.
- Jurisdictions that lack access to very large consumer markets, such as Alberta, are advised to select niche areas if they want to develop clusters of research expertise and business activity.

As Alberta looks to expand and diversify its food research and innovation landscape, it is useful to examine major initiatives in other jurisdictions for lessons and strategies. A scan of the international environment and interviews with key stakeholders in business, government, academia, and other institutions identified three important initiatives from which Alberta could learn—the Netherlands Food Valley, Australia’s Food and Health Dialogue, and Scotland’s Food and Health Innovation Services. Analysis of each case includes description of objectives and activities, key outcomes, challenges, and specific lessons.

The Netherlands’ Food Valley

The Netherlands’ Food Valley is regarded by many as the world’s leading centre of food innovation research and collaboration. Interviewees for this project mentioned it far more often than any other initiative as worthy of careful study and analysis. Indeed, the Netherlands is doing an noteworthy job in food innovation—from the perspective of both economic and health impact—and its efforts provide many lessons for Alberta.

What is the Holland Food Valley?

The Food Valley is “world’s largest concentration of high quality research centers, innovation clusters and pilot plants engaged in food, food technology and process design.”³⁹¹ There is a very high level of collaboration between industry, researchers, and government agencies with a view towards developing new and improved food products and production practices that can contribute to a sustainable and healthy food supply, as well as to economic development. Additionally, the Netherlands Foreign Investment Agency works to attract global companies to locate in the valley and work with Dutch researchers, thereby cementing its status as a global centre. In particular, the Valley is home to:

³⁹¹ Food Valley NL, *Growing Innovations in the Netherlands’ Food Valley*.

- many national and international agrifood companies, including 12 of the world’s top 40 food and beverage businesses—such as Nestle, DANONE, Heinz, Unilever, and Kellogg Company;³⁹²
- numerous research centres, including Wageningen University and Research Centre, and many institutes focused on specific areas of food research and innovation;³⁹³ and
- 15,000 professionals involved in food-related sciences, technological development, and food manufacturing.³⁹⁴

The high concentration of businesses and researchers is both driven by and benefits from the Netherlands’ very favourable geographic reality. There are approximately 170 million consumers within 500 km of the valley—including in France, Luxembourg, Germany, the United Kingdom, and the Scandinavian countries. The number of consumers nearly doubles when the radius is extended to 1,000 km, and nearly triples to 800 million within 1,300 km.³⁹⁵ Access to this sizable consumer market is a key feature that attracts international food businesses to work with researchers in the valley.

Activities

The goals of the various organizations based in the valley are as varied as they are. Industry is generally interested in benefitting from research that helps them produce the kinds of products consumers are demanding and which could keep them on the cutting edge. Government organizations and participants want to see improvements in the health and safety of the food supply and better health outcomes for consumers, but also economic benefits such as jobs and higher tax revenues. Researchers are interested in pushing the boundaries of knowledge while also contributing to the health, safety, and environmental sustainability of the food system. The Food Valley is most successful when these objectives align in food research and innovation.

A key contributor to aligning these objectives is Food Valley NL—an organization jointly funded by business and government to support food innovation. Founded in 2004, Food Valley NL characterizes its activities as “matchmaking”—i.e., facilitating collaborations and assisting food businesses in finding the expertise they need to conduct food research and innovation.³⁹⁶ In particular, the organization:

- brings together businesses and research institutes in goal-oriented clusters;
- assists start-up food businesses with project proposals and securing funding;
- matches domestic and foreign companies with relevant businesses and researchers in the Food Valley; and

³⁹² M. Schans, “Agri-food in the Netherlands.”

³⁹³ Food Valley NL, *Growing Innovations in the Netherlands’ Food Valley*.

³⁹⁴ Food Valley NL, *Growing Innovations in the Netherlands’ Food Valley*.

³⁹⁵ M. Schans, “Agri-food in the Netherlands.”

³⁹⁶ Food Valley NL, *Profile*.

- facilitates the exchange of knowledge and ideas between researchers, businesses, and other participants.³⁹⁷

When it comes to funding research, the government’s approach is to have the long-term strategic goals of research generally set by industry. This reflects the recognition that unless there is an industry receptor capacity, research results will not find application in the market. At the same time, how research is conducted and the integrity of results are elements controlled by the researchers—usually academics—to ensure that they are free of industry bias.³⁹⁸ To be sure, there is still tension between business and researchers in both the selection and execution of research. Many researchers raise concerns about the power industry has to set research directions, while many businesses complain that much research lack commercial value.³⁹⁹ Nevertheless, the arrangements and dynamic tension have produced some productive institutes and partnerships, including:

- NIZO Food Research – a leading food research company which collaborates with Dutch researchers and focuses on flavour, texture, processing, health, and food safety innovations;
- The Netherlands Organisation for Applied Scientific Research – a leader in nutrigenomics and in establishing biomarkers which allows it to perform research into the beneficial effects of certain foods and ingredients for weight control; heart, vascular, and intestinal health; and the immune system;
- Top Institute Food & Nutrition – a public-private partnership whose research contributes to food product innovation, including innovation related to safety, taste, convenience, and health; and
- Food and Nutrition Delta – a program focused on developing and sharing new technologies that can contribute to food innovation, particularly those which could have a positive impact on health and well-being.⁴⁰⁰

Outcomes

With funding and support from the government, researchers and businesses in or associated with the valley are achieving significant results. The Top Institute Food & Nutrition for example, can boast about considerable achievements, including:

- a research citation impact two times higher than the world average;
- collaboration with five new top international businesses; and
- application of research in new products with a national turnover of €710 million.⁴⁰¹

³⁹⁷ Food Valley NL, *Profile*.

³⁹⁸ Interview with official in the Netherlands Foreign Investment Agency, and expert in the Food and Nutrition Delta. Telephone interview by Daniel Munro, May 2013.

³⁹⁹ Interview with official in the Netherlands Foreign Investment Agency, and expert in the Food and Nutrition Delta. Telephone interview by Daniel Munro, May 2013.

⁴⁰⁰ Food Valley NL, *Growing Innovations in the Netherlands’ Food Valley*.

⁴⁰¹ M. Schans, “Agri-food in the Netherlands.”

Meanwhile, the Food and Nutrition Delta has witnessed:

- research partnerships with more than 380 businesses, 90 per cent of whom are small or medium-sized businesses and 70 per cent of whom are new in the innovation system;
- work on over 200 projects;
- the creation of 248 new jobs by 25 businesses; and
- turnover of €126 million.⁴⁰²

Additionally, the efforts of researchers, businesses, and government officials to improve the health of the food supply through innovation and regulation has contributed to measurable health improvements in the population. The Netherlands has witnessed a decrease in sodium consumption for the first time since it began tracking consumption, which observers attribute to a significant reduction in the amount of salt in baked goods—an achievement that required both technological innovation and changes in bakers’ behaviour.⁴⁰³

Lessons

The Netherlands’ Food Valley experience provides useful insights and lessons for Alberta and other jurisdictions.

- *Strong linkages between researchers and business are critical.* According to Linnie Mackenzie, Area Director of the Netherlands Foreign Investment Agency, “fostering the transfer of knowledge between firms and research institutes is the key to success.”⁴⁰⁴ It is not enough simply to fund research that may be relevant to food innovation. Rather, direct assistance and support must be provided to ensure that researchers and businesses are talking, collaborating, and contributing to the implementation and commercialization of results.
- *Allowing industry to select overall research priorities can improve performance.* Although tensions between researchers and industry are likely to persist, giving business a stronger voice in identifying research priorities can help close the gap between research that is rigorous and research that is both rigorous and relevant. At the same time, governments play a large role in establishing health priorities and targets through regulation and researchers remain responsible for the quality and integrity of the research and understanding they produce.
- *Access to a very large consumer market is a key condition for success.* A key element of the Netherlands’ Food Valley’s success is brute geography. Its strategic location in Europe allows businesses incredible access to hundreds of millions of consumers. Unfortunately, Alberta is home to less than 4 million people and only a few medium-sized markets (such as B.C. and states in the American northwest) reside within a 1000km radius of researchers at the University of Alberta or University of Calgary. This makes it very unlikely that the province

⁴⁰² M. Schans, “Agri-food in the Netherlands.”

⁴⁰³ Interview with official in the Netherlands Foreign Investment Agency, and expert in the Food and Nutrition Delta. Telephone interview by Daniel Munro, May 2013.

⁴⁰⁴ Food Valley NL, *Growing Innovations in the Netherlands’ Food Valley*.

could attract a substantial presence from and research engagement with globally operating food businesses. There may be opportunities for one or two niche clusters—such as in food nanotech and meat safety—but little chance of a larger and more diverse cluster.

In short, the lessons for Alberta that arise from analysis of Netherlands’ Food Valley are that the province should focus strategically on niche areas and ensure that industry is involved and supported at the key moments of priority identification and results implementation and commercialization. Indeed, as highlighted earlier in the report, research which is not regarded as relevant and adopted by food businesses can have no impact on the food supply or economic development and diversification.

Australia Food and Health Dialogue

Like other jurisdictions, Australia is increasingly aware of and concerned about the link between poor dietary habits, food-related diseases, and their social and economic consequences. In 2009, the Food and Health Dialogue (the Dialogue) was created to improve Australian’s dietary habits by providing “a framework for government, industry and public health groups to work collaboratively, on a voluntary basis, to address poor dietary habits and promote healthier food choices for all Australians.”⁴⁰⁵

Overview

The Dialogue is an initiative of Australia’s Department of Health and Ageing. It is governed by an Executive Group (chaired by the Parliamentary Secretary for Health and Ageing) that includes representatives from a number of food and health-related non-governmental organizations (including scientific and research organizations focused on food and disease), private sector businesses (including major businesses in food retail and food service), and public sector organizations, and public sector organizations.⁴⁰⁶

The Dialogue’s activities are carried out by a Reformulation Working Group, which identifies priority food issues to be addressed by government and industry partners. The Reformulation Working Group convenes industry roundtables organized around specific food product categories (breads, cereals, sauces, etc.), to “discuss and agree to approaches that support the Dialogue’s public health objectives, including reformulation, portion sizing and consumer messaging targets.”⁴⁰⁷ The roundtables then develop Food Category Action Plans that include objectives and targets endorsed by industry participants, and that outline the steps that industry will take to achieve them.

⁴⁰⁵ Interview conducted by the Conference Board.

⁴⁰⁶ Department of Health and Ageing Australia, *About Us*.

⁴⁰⁷ Department of Health and Ageing Australia, *About Us*.

Drivers and Objectives

The Food and Health Dialogue emerged following the 2007 National Children’s Nutrition and Physical Activity Survey which identified poor dietary habits among Australian children—in particular, high consumption of salt and saturated fat, and low consumption of fruits and vegetables. The Dialogue was officially launched in October 2009 with the primary objective to “[address] poor dietary habits and [make] healthier food choices easier and more accessible for all Australians.”⁴⁰⁸

To achieve this objective, the Dialogue focuses on the reformulation of widely-consumed food products, which are selected on the basis of market data and nutritional information, to improve their nutritional profile.⁴⁰⁹ Reformulation involves reducing the amount of “risk-associated nutrients” in the food supply, including sodium, sugar, and saturated fat, and increasing healthy ingredients such as fibre and whole grains.⁴¹⁰ Importantly, reformulation targets are designed to be achievable “without the consumer detecting any change, gradually changing the consumers’ palette over time.”⁴¹¹

The Dialogue attempts to maximize the public health outcomes of its reformulation efforts by:

1. engaging at least 80 per cent of manufacturers in a given food category, and;
2. encouraging manufacturers to reformulate products that have the highest volumes.⁴¹²

Outcomes

The Dialogue monitors progress on setting and achieving reformulation targets. As a result of the Dialogue’s efforts to date, industry partners have agreed to 17 reformulation targets in the area of sodium reduction across eight food product categories: bread, ready to eat breakfast cereal, simmer sauces, processed meats, soups, savoury pies, savoury crackers and potato/corn and extruded snacks.⁴¹³ The Dialogue also attempts to understand the population health impacts of its reformulation activities. It is estimated that successfully implementing the reduction targets of four of the food categories mentioned above will result in approximately 2200 tonnes of salt removed from Australia’s food supply ever year—a number that will increase as more food categories are engaged through the Dialogue.⁴¹⁴

Timeframes to achieve reformulation targets vary by food category, with all set to be met no later than 2015. However, recent progress updates show that food companies are making progress towards these goals, and that some targets have already been achieved. For example, in the area of “savoury pies”, 45 out of 58 products are anticipated to be reformulated and

⁴⁰⁸ Department of Health and Ageing Australia, *About Us*.

⁴⁰⁹ Interview conducted by the Conference Board.

⁴¹⁰ Department of Health and Ageing Australia, *Industry Engagement*.

⁴¹¹ Interview conducted by the Conference Board.

⁴¹² Interview conducted by the Conference Board.

⁴¹³ Department of Health and Ageing Australia, *Summary of Food Categories*.

⁴¹⁴ Parliamentary Secretary for Health and Ageing, *Food and Health Dialogue Communique*, 1.

commercialized by the end of March 2014.⁴¹⁵ And half of newly launched products meet and exceed the Dialogue’s targets for sodium reduction.⁴¹⁶ Agreement has also been achieved for the reduction of saturated fats in processed meats, though timeframes to achieve reformulation targets do not appear to have been set.

Although reformulation is the Dialogue’s primary focus, efforts are also made to address other issues related to poor dietary health. For example, given the increasing amount of food consumed away from the home, the Dialogue has engaged the “quick service” (fast food) sector to reduce standard portion sizes, improve nutrition, and “educate consumers about how to make healthier food choices.”⁴¹⁷ However, specific objectives and targets do not appear to have been set for these efforts as of yet.

Keys to Success and Challenges

The Dialogue is a platform for voluntary collaboration between public and private organizations to improve the diets of Australians. As such, the ability to foster cooperation among different stakeholders is essential to the program’s success. According to one interviewee, “the collaborative approach, with open communication between the Dialogue participants and a clear progression of steps for the food reformulation process, has been central to the action achieved to date.”⁴¹⁸

To facilitate participation of industry, various government agencies prepare background studies and work on feasibility and market impact. In particular, Australia’s National Heart Foundation conducts research on specific food reformulation targets, market share, and nutritional data for priority food categories, while the Commonwealth Scientific and Industrial Research Organisation examines technical considerations related to reformulation. Although these efforts can be time-consuming, the results they produce help to ensure that reformulation targets are achievable, will be supported by food industry partners (such as manufacturers and retailers), and will contribute to public health goals.⁴¹⁹

Reformulation timeframes are also aligned with industry capacity. On this point, however, representatives of the Dialogue acknowledge that the length of time required to develop and achieve reformulation targets can be considerable—and that some public health groups have expressed concern about an inadequate rate of progress.

Future Direction

In May 2013, the government announced that the Dialogue would receive \$800,000 to continue to pursue its mandate.⁴²⁰ The Dialogue intends to expand the range of food categories it

⁴¹⁵ Parliamentary Secretary for Health and Ageing, *Food and Health Dialogue Communiqué*, 2.

⁴¹⁶ Parliamentary Secretary for Health and Ageing, *Food and Health Dialogue Communiqué*, 2.

⁴¹⁷ Interview conducted by the Conference Board.

⁴¹⁸ Interview conducted by the Conference Board.

⁴¹⁹ Interview conducted by the Conference Board.

⁴²⁰ Parliamentary Secretary for Health and Ageing, *Food and Health Dialogue Communiqué*, 1.

addresses, including those in the area of “processed poultry, cheese, potato/corn and extruded snacks, noodles and condiments.”⁴²¹ Other government initiatives and collaborations are expected to improve the Dialogue’s ability to address food-related risks. For example:

- Findings from an upcoming national survey, conducted by the Australian Bureau of Statistics, will provide a better understanding of actual levels of sodium intake that will help inform future reformulation strategies.
- A national Food Composition Database is under proposal, which would enable the comparison of nutrient information over time, and better support the Dialogue’s activities and the communication of program results.

Along with these initiatives, a new “Front of Pack” labelling system—to be developed and implemented in Australia over the next 12 months—is anticipated to complement the work of the Dialogue and its ability to improve the dietary health of Australians.⁴²² The system will provide a standardized label system for “all packaged, manufactured or processed foods”—including a star rating system, based on a Nutrient Profiling Scoring Criterion—and improved nutrition information practices. The system will likely involve voluntary implementation, unless implementation is found to be unsuccessful after two years (in which case “a mandatory approach will be required”).⁴²³

Lessons

The Dialogue is a young program—it will take several years for more reformulation targets to be achieved and for the strengths and weaknesses of the program to be fully understood. Nevertheless, the Dialogue can already point to some successes, largely in the area of sodium reduction, and its collaborative model and approach to reformulation can be instructive to other jurisdictions pursuing the same objectives.

- *Incremental works.* Although small, incremental changes to the nutritional profile of popular foods (e.g. a reduction of sodium) will not solve all of the health-related challenges of the food system at once, enough small changes can add up to a significant step towards a healthier food supply. Incremental changes—ones that do not result in a detectable change to a product’s taste and that do not impose excessive costs and burdens for industry to implement—may take time to result in measurable improvements to population health. However, they may also be a more effective strategy for securing lasting improvements to the food system: Consider, for example, the failure of other jurisdictions’ efforts that were considered excessively prohibitive and costly, such as the Danish “fat tax” (introduced in 2011 and repealed in 2012).⁴²⁴
- *Collaboration works.* Industry can be motivated to improve the nutrition of food products when they have input into the design of reformulation targets and timeframes, ensuring that

⁴²¹ Department of Health and Ageing Australia, *About Us*.

⁴²² Department of Health and Ageing, ‘*Front of pack labeling*.’

⁴²³ Department of Health and Ageing, ‘*Front of pack labeling*.’

⁴²⁴ O. Khazan, “What the world can learn from Denmark’s failed fat tax.”

they are technically feasible and can be implemented over practical timeframes (and sometimes beginning with new product lines). Engaging a wide group of stakeholders—including many industry partners—in collective action around food reformulation also has the advantage of not disadvantaging any single first adopter in the marketplace.

Scotland’s Food and Health Innovation Service

Scotland’s Food and Health Innovation Service (FHIS) addresses an important need for Scotland’s food entrepreneurs and innovating SMEs. The ultimate objective of FHIS is to provide companies that have growth potential, or are entering the market for food and health, with a “[s]eamless and tailored package of support from idea generation to project implementation.”⁴²⁵ It accomplishes this by bringing under one umbrella a range of services offered through partnering organizations—thereby acting as a one-stop portal for support and guidance. Services are offered free of charge to Scottish industry, and are broken down into two main types:⁴²⁶

- Technical support, including:
 - reformulating products to improve nutritional profile (such as reducing sugar, fat, or salt);
 - developing new food products, including functional foods and drinks;
 - designing innovation plans that identify partners, sources of funding, and technical solutions.
- Marketing support, including
 - market research through Scotland Food & Drink Insights;
 - custom assistance with marketing and legislative support (e.g. how to make a health claim through the European Food Safety authority); and
 - access to a network of marketing experts.

Through these services, companies can receive the assistance and guidance they need to navigate the tasks and challenges of the innovation and commercialization processes. Companies express their needs and interests and are given innovation roadmaps that plot out the necessary steps they must take to achieve them. This is an invaluable service for Scotland’s many SMEs, which (like SMEs in Canada) often face considerable challenges and barriers to innovation without guidance and support. The FHIS also runs information and technical events, networking meetings, etc.—all of which are free of charge as a service of Scottish Enterprise.

Drivers and Objectives

Scotland has big ambitions for its food industry, and healthy food innovation can play a key role in helping achieve them. The food industry has long been a key sector of the Scottish economy, generating over £9.5 billion per year and employing 360,000 people.⁴²⁷ In recent years, however,

⁴²⁵ Richardson, “Food and Health Innovation Service.”

⁴²⁶ See The Food and Health Innovation Service, *About*; and P. Richardson, “Food and Health Innovation Service.”

⁴²⁷ The Scottish Government, *Recipe for Success*, 5.

the government identified food as a priority growth area, and set ambitious targets to increase overall food sales to approximately £10 billion by 2017, up from £7.5 in 2007.⁴²⁸ It is estimated that growing sales in the healthy food market could contribute to this by adding £685m in revenues for Scottish companies by 2017.⁴²⁹

Improving health outcomes for Scottish citizens and reducing the burden of food-related disease on the health care system is also a government priority. As noted in Scotland’s national Food and Drink policy, “[p]oor diet and excessive consumption of food and drink contributes directly to the high rates of the main causes of death (heart disease, stroke, cancer, diabetes) and poor health (obesity, dental decay) in Scotland.”⁴³⁰

It was recognized that there is an opportunity to support the objectives of economic development in addition to improving the health of Scottish citizens. FHIS emerged as a collaboration between Scotland Food and Drink (the main food industry association) and Scottish Enterprise (an economic development organization) with an initial five-year mandate to pursue these objectives. As one interviewee noted, “we’re killing two birds with one stone—innovating in the area of food and drink while improving Scottish health. That’s really where it [FHIS] came about.”

At an operational level, FHIS services are led and delivered by Camden BRI, an organization that provides technical assistance and other resources to food industry in the UK and around the world.⁴³¹ Four partnering organizations are sub-contracted to assist in the delivery of FHIS services—including academic institutions, producer groups, marketing specialists, and others—each bringing different resources and services to the overall FHIS consortium.

At £4.4 million over five years, FHIS represents the largest investment into a single program that has been made by Scottish Enterprise in the recent past.⁴³² Its mandate is to assist 400 companies over a five year horizon—a target that it is well on its way to achieving. In helping these companies innovate and generate additional revenues, FHIS also works to promote innovation linkages throughout the food system, including utilizing Scottish ingredients and inputs to improve nutritional content in foods.

Implementation and Key Challenges

FHIS was not created overnight. It took over ten years to develop and implement the program before it was officially launched in 2011. The process involved putting out many tenders for contracts before the final organization of partners and services was established. In addition, the initial idea was subjected to multiple pilot studies before FHIS was finally initiated. At this point, Camden BRI began the work of developing a model for interacting with companies and delivering the program suite.

⁴²⁸ The Scottish Government, *Recipe for Success*, 6.

⁴²⁹ The Food and Health Innovation Service, *About*.

⁴³⁰ The Scottish Government, *Recipe for Success*, 11.

⁴³¹ See Camden BRI, *Overview*.

⁴³² Interview conducted by the Conference Board.

A key challenge, according to one interviewee, was in deciding on the roles and responsibilities of each of the partnering organizations, ensuring alignment with the overall objectives, and keeping each focused on its respective role to add value to the consortium as a whole. This was considered paramount for the program to provide a seamless experience for the companies involved—a challenge, given that many partners were able to provide some degree of all the services. Overcoming this set of challenges required building mutual trust between the partnering organizations and Scottish Enterprise. Lots of “bridge building” was necessary from the outset.

Outcomes and Future Direction

Some quantitative information about the program’s outcomes is available. To date, the program has assisted 200 companies with their innovation and commercialization needs, and 300 more are in the pipeline. The program is therefore on track to exceeding its initial target of assisting 400 companies. Qualitative evidence of success—in the form of case studies of company achievements—is also available. Success stories include the development of new food products and processes among companies in different sectors and stages in the food system. For example, FHIS’ activities have enabled:⁴³³

- an entrepreneur develop a new line of healthy cereal bars for domestic and export markets, featuring gluten-free, low sugar, and high sugar and fibre content;
- a chain of butcher and meat retail outlets reformulate sausage lines to replace artificial preservatives and colours with natural ones;
- a start-up develop a “nutritionally balanced” product line in partnership with university researchers in human nutrition, beginning with frozen pizza;
- a company develop the concepts, market strategies, and partnerships, that eventually led to the creation of a new facility to produce healthy sea water-based products (able to reduce dietary sodium).

Although the program only has a five year mandate, key personnel believe that it will have a lasting benefit, even if its mandate is not extended. As one interviewee put it, “the whole business is about getting companies to realize they’re not alone—there is a community that can work with you.” Another interviewee added that given the dominance of SMEs in Scotland’s food economy, the program will be a success if companies are able to develop their own, self-sustaining “communities of practice” in the area of food and health innovation. This involves positioning Scottish industry to collaborate better, understand and navigate the food innovation environment and take advantage of its resources, and increase their own investments into healthy food innovation.

⁴³³ Case studies can be viewed on the FHIS website: www.foodhealthinnovation.com/case-studies/.

Lessons

Scotland’s FHIS is an innovative approach to supporting healthy food innovation that other jurisdictions can learn from.

- *Integrate existing resources to maximize effectiveness.* Scotland is a jurisdiction that, like Alberta, has a multitude of organizations able to support food innovation, through funding, market development, and technical assistance (including basic and applied research)—though the efforts of these organizations are not always aligned or mutually supporting. The FHIS approach is based on the understanding that there is much that can be done to improve the effectiveness of existing resources to bolster food innovation, by integrating and coordinating some of their activities through a single program. For food businesses and entrepreneurs, such a system has the advantage of overcoming an important obstacle—a lack of understanding of where to find guidance and support.
- *Develop self-sustaining innovation clusters.* Developing and integrating new innovation support structures can take time. FHIS required over 10 years of development before it could begin to generate value for Scotland’s food businesses—time that was needed to define program objectives and parameters, establish partnerships and working relationships, and undertake pilot studies to determine program feasibility and value. Over its 5 year mandate, the program is expected to assist hundreds of food firms to achieve their innovation objectives. But the longer term benefits of the program are anticipated to have even more value, as the linkages that have been established through FHIS contribute to a self-supporting food innovation cluster—able to contribute value for the country in perpetuity.

Conclusion

From this examination of international initiatives, a number of lessons emerge for Alberta. In particular, the importance of engaging with industry cannot be overstated. Food research and innovation which aims to have any impact on the economy and/or health outcomes must ensure that industry is engaged, otherwise there is no mechanism for improvements to occur. Additionally, developing clusters of expertise is a useful strategy, but there must be a market of sufficient size to support cluster activities and products. In Alberta’s case, the consumer market is very small—even within a 1000km radius of major centres—thus there will be a need to focus clusters on very specific niche activities and/or to explore promising export market opportunities. In any case, what is clear is that successful initiatives depend on well-resourced, collaborative action by researchers, government, intermediary organizations, and especially the food industry.

Chapter 7

Recommendations and Strategies

Chapter Summary

- Alberta has strong research opportunities in ingredients and value-adding opportunities; functional foods, nutraceuticals, and fortification; and meat safety; and promising opportunities based on strong research capacity in genomics and food nanotechnology.
- The province may have opportunities in special dietary needs and potato- and pulse-based indulgence/snack foods where industry capacity and market demand is strong, but where research capacity and needs are unclear.
- Achieving commercial and social success will require strategies to address key challenges including forming stronger links between researchers and industry, the need to support opportunities with national and global potential, improving competitiveness, and the complex relationship between the determinants of dietary patterns and health outcomes.
- Coordinated efforts by all Alberta stakeholders will be needed to ensure that food research and innovation contributes to economic development and diversification and improvements in health and environmental performance.

This report has identified a subset of the most promising food research and innovation opportunities for Alberta. Identifying these opportunities is a first step in the process of realizing the opportunities and reaping the economic and social benefits of their successful development and commercialization. After reviewing the main opportunities, this chapter provides recommendations about how to move further to realize those opportunities and achieve results.

Promising Research and Innovation Opportunities

Based on the methodology and analytical approach outlined in Chapter 1, we have identified key areas where research and innovation opportunities make the most sense for AI Bio Solutions.

When we focus primarily on the intersection of market demand, research capacity, and industry capacity, the following opportunities stand out in the analysis:

- The strongest alignment occurs in three areas:
 - Certain areas of **ingredients and value-adding opportunities** show great promise—particularly where they overlap with Alberta’s livestock and crop sectors. In these areas, strong research capacity is complemented by exceptionally strong industry capacity. So long as bridges between the research and industry communities can be built and maintained, there is reason to believe that this could be a very significant source of economic value for Alberta’s food sector.
 - Certain kinds of **functional foods, nutraceuticals, and fortification** initiatives are also promising, particularly in the areas of barley/beta-glucan, functional pulse-based

- ingredients, and dairy protein. Here we find a high degree of alignment between market demand, research capability, and industry capability.
- **Food safety**—and especially **meat safety**—is the third stand-out area where research and industry capacity align and there is market demand. This is of huge importance to the Alberta and Canadian agri-food industry. Failures in food safety have a massive impact on Alberta because it is a specialization of the agri-food economy.
 - Somewhat strong alignment—and thus reason for investment—also emerges in:
 - **Genomics**. Alberta’s research capacity in *genomics* and the potential for commercial applications are strong. Although the industry capacity to develop and implement applications is less than ideal, it is not entirely absent. With sufficient support, this could be an area of emerging strength for the Alberta food sector.
 - Two other kinds of functional food, fortification, and nutraceuticals applications—**poultry bioactives** and **choline**—also show strong research capacity and some industry capacity, but less apparent evidence for market demand. In this case, a good strategy may be follow the lead of the industry players as they determine whether pursuing these areas makes sense from a market demand point of view.
 - **Food nanotechnology** is also worth considering. Although there is little in terms of existing industry capacity in the province, the very strong research capacity in nanotechnology in Alberta is an opportunity ripe for development. Alberta would benefit, in our view, from entrepreneurial endeavours spun off from its research capabilities in nanotechnologies.
 - **Potato and pulse-based snack foods**. Alberta has both extraordinary market opportunity and industry capacity in this area. What is unclear is the extent to which research capacity is available to support growth or, for that matter, whether non-industry research capacity is required. We flag this as an area that Alberta Innovates Bio Solutions should investigate further.
 - Finally, there are two areas where there is industry capacity and market opportunity, but where the research capacity is weak or unknown.
 - Alberta has both extraordinary market opportunity and industry capacity in **potato and pulse-based snack foods**, but the state of research capacity is unclear. We flag this as an area Alberta Innovates Bio Solutions should investigate further. There may be unmet research needs which would find quick adoption by industry and achieve market success. The best approach may be to consult with industry to determine their research needs in this area.
 - Alberta has good market opportunity and industry capacity in **special dietary needs** research and innovation, but the available evidence is not clear on research capacity. It may be that there are no or very few researchers in Alberta working in this area, or that there are some but were not identified by our research. This is an area that Alberta Innovates Bio Solutions may want to investigate further.

When we add a concern for social impact—particularly health impact—the terrain changes somewhat. In this case, the potential health impacts of the opportunities listed above is highest in food safety-related research and innovation opportunities, as well as special dietary needs opportunities. For most other opportunities, the potential health impacts are moderate and ultimately depend on the dietary patterns and behaviours of consumers. No, or possibly negative, health impacts would emerge from snack-based innovation, but this also depends on consumers’ dietary patterns. What weight Alberta Innovates Bio Solutions wishes to place on the health criteria would help determine which of the opportunities would be best overall.

Strategies for Success

In addition to helping identify and characterize food research and innovation opportunities, interviews and survey data for this project uncovered a range of challenges and ways to overcome them in order to achieve maximum results. And as the report shows, there is no opportunity in Alberta that achieves perfect scores across the relevant criteria. In fact, nearly every opportunity faces one or more significant barriers to success. What steps can Alberta Innovates Bio Solutions and other stakeholders in Alberta take to ensure that investments in specific research and innovation opportunities actually lead to successful results for society and the economy?

Improve Links Between Industry and the Research Community

It is not enough simply to fund research that may be relevant to food innovation. Direct assistance and support needs to be provided to ensure that researchers and businesses are talking, collaborating, and contributing to the implementation and commercialization of results. Unfortunately, according to many interviewees, many of the links between researchers and industry in many parts of the Alberta food sector are weak. To be sure, there are many intermediary organizations and associations that are helping to bridge the gap, including the Agri-Food Discovery Place and the Leduc Food Processing Development Centre. But Alberta is still some distance from the kind of close collaboration seen in the Netherlands.

One way to improve the quality and extent of discussion between researchers and industry, with a view towards ensuring that research results in implemented processes and commercialized products, is to give industry a greater role in selecting research priorities. As the Netherlands Food Valley shows, although tensions between researchers and industry may persist, giving business a stronger voice in identifying research priorities helps to close the gap between research that is rigorous and research that is both rigorous *and relevant*. Short of bringing industry into the opportunity selection process directly, it would be helpful if researchers and research funders selected opportunities with an eye on specific companies who could commercialize the findings.

Support National and Global-Facing Initiatives and Companies

With a population under 4 million and total expenditure on food amounting to just over \$10 billion, Alberta is a small market. Even the consumer market within 1000km of the province is small by international standards. This does not mean that the province should not aim to develop

and diversify its food sector—in fact there are some genuine areas of opportunity and growth. It does mean, however, that the province should focus as it is unlikely to attract significant industry investment in more than a few key areas and unlikely to find itself the research destination of choice for globally operating food businesses.

Still, as researchers, investors, and industry in Alberta’s food sector make decisions about strategic focus and innovation opportunities, they would be well-advised to have an eye on initiatives that have national and global, and not simply provincial, relevance. For example, meat safety is a key opportunity in large part because of the global market presence and potential Alberta has in this area. Additionally, the province’s research expertise in nanotechnology provides a platform for national, and potentially global, excellence. Developing nationally and globally competitive subsectors of Alberta’s food industry will be challenging, long-term initiatives, but focusing only on the province provides too few opportunities to succeed.

Conduct Detailed Competitive Analyses

This report identifies research and innovation opportunities that align with market demand and Alberta’s research and industry capacity. Although it situates Alberta’s food innovation performance in a global context—and indicates what key competitor nations are doing in adjacent areas—it was beyond the scope of the report to examine in detail the activities of rival organizations, including research organizations and food businesses. To ensure that Alberta Innovates is investing in areas in which the province and its food businesses can gain a competitive advantage, it would be advisable to conduct a more fine-grained competitive analysis of potential rivals in specific innovation areas in other jurisdictions. Indeed, Alberta Innovates will want to ensure its research investments provide a foundation for Alberta food businesses to be either first-to-market with new innovations and/or produce better products and services relative to competitors.

Support Initiatives to Improve Dietary Patterns

Finally, as we note throughout the report, efforts to improve food-related health outcomes should not focus on the food supply alone. There are too many other factors that influence dietary patterns and consumer health which, if left unaddressed, could undermine any positive achievements in the food supply through research and innovation. Consequently, to achieve substantial health improvements, food research and innovation need to be accompanied by policies and initiatives that address the full spectrum of determinants of consumers’ dietary patterns of consumers. Although this may not be squarely within the mandate of Alberta Innovates Bio Solutions, its aim to improve health outcomes depends on action being taken in this area. At a minimum, Alberta Innovates Bio Solutions should consider allocating some portion of its investment budget to research that would improve understanding of the factors that affect dietary patterns and assessment of programs designed to achieve better outcomes.

The Future of Food Innovation in Alberta

Alberta has a wealth of opportunities in food research and innovation, but achieving specific economic and social objectives requires careful selection and pursuit of relevant initiatives. Several areas of food research and innovation can help Alberta develop and diversify its economy and contribute to improvements in health and environmental performance. They include research in ingredients and value-adding opportunities; some functional foods, nutraceuticals, and fortification; and food safety. Potential opportunities also exist for research and innovation in nanotechnology; genomics; potato- and pulse-based snack foods; and special dietary needs.

Seizing opportunities and achieving maximum benefits requires a strategic approach to addressing key challenges in the food sector in Alberta—particularly, the need to improve alignment and communication between the research community and the food industry, the need to pursue national and global opportunities given Alberta’s small market, and the fact that health improvements depend not only on food supply solutions, but also action on the full range of determinants of consumer choices. With the right mix of research investments and support to key stakeholders, there is every reason to believe that Alberta’s future will see a more competitive and prosperous food sector and a healthier population.

Appendix A

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