

23 *Trending Now*  
Health Canada proposes label makeover

32 *Reviews*  
The roles of physics in foods

41 *Around the Country*  
Poultry research thrives

# Canadian *food* Insights



The official magazine of

 **CIFST**  
www.cifst.ca

# HIGHER LEVEL FLAVOUR.



## INCREASING YOUR POTENTIAL TO CONVINCe WITH FLAVOUR—EXPONENTIALLY

At Sensient, **superlative flavour starts at the atomic level and extends to a world of possibilities.** Our craftsmanship approach envelopes both the art and science of food flavour development. Whether you are looking for the perfect sweet, savoury, beverage or dairy partner, let Sensient show you the way to satisfy customers from the tip of their tongues to the top of your category. We think globally, yet we produce and support our customers locally. **Contact us now and let us prove to you how our craftsman approach—and unique market insights—can mean happier customers for you.**

 **BASED IN CANADA**  
SENSIENT® FLAVORS CANADA INC.

905-826-0801 | 7200 West Credit Avenue, Mississauga, ON L5N 5N1  
sfc-service@sensient.com

©2013 Sensient Flavors Canada INC, all rights reserved. Sensient Flavors Canada is a business unit of Sensient Technologies Corporation. The SENSIENT trademark and the Sensient Technologies Corporation logo are owned and registered by Sensient Technologies Corporation. All rights in trademarks are reserved.



We bring life to products™  
[SENSIENTFLAVORS.COM](http://SENSIENTFLAVORS.COM)



## WHY WE ARE POURING OVER \$2 MILLION INTO NATURAL COLOUR TECHNOLOGY IN CANADA



**We are completing \$2,000,000 in improvements** at our manufacturing and research facility in Canada—including major upgrades to our liquid processing plant. The investments we are putting into Canada will help you get more benefits out. Sensient is working hard every day to create easy, compatible, turn-key colour solutions to advance the natural colours market for our customers. As a result, we are quickly closing the gap between natural colour science and certified colour technology. Sensient is the global leader in colours for the food and beverage industry. Our innovations help you differentiate your brand in the marketplace. **We do the work. You receive the benefits.**

 **BASED IN CANADA**  
Established 1923

SENSIENT® COLORS CANADA LTD.

800-267-7884 | 30 River Street, Kingston, ON K7L 4X6  
scc-sales@sensient.com

©2013 Sensient Colors LLC, all rights reserved. Sensient Colors Canada is a business unit of Sensient Technologies Corporation. The SENSIENT trademark and the Sensient Technologies Corporation logo are owned and registered by Sensient Technologies Corporation. All rights in trademarks are reserved.



Define and protect your brand  
[SENSIENTCOLORSCANADA.COM](http://SENSIENTCOLORSCANADA.COM)

# 2015 Trends 18

Innova Market Insights gives us the scoop on trends that will drive the industry.



## feature REVIEWS

**28 Food Irradiation Adds Cost but Makes Sense**  
A look at how irradiation can be strategically used to improve the safety of food and the health of Canadians.

**32 The Roles of Physics in Foods: modelling, computer simulation and things you probably never knew about**  
The science of physics has proven to be a valuable asset within the industry, optimizing and improving the products we consume.

**35 Supercritical Carbon Dioxide Technology for Food and Natural Health Products**  
Fueled by increasing demand, supercritical carbon dioxide extraction and fractionation of natural ingredients have become popular in the growing functional food and natural health products industry.

### feature stories

- 14 MORE THAN BREAD**  
Saskatchewan moves its image beyond the traditional breadbasket and toward the value-added ingredient industry.
- 23 CLEAR LABELS**  
Health Canada proposes changes to the Nutrition Facts table that could have major impacts on food producers.
- 41 FUELING CANADA'S POULTRY CLUSTER**  
The Canadian Poultry Research Council is at the centre of a huge group that supports 17 research activities conducted by 59 researchers from 24 organizations.



**CLICK HERE for your FREE subscription –**

TRY IT, YOU'LL LOVE IT!

### regular departments

- 6 LETTERS
- 10 SHOPPING CART
- 14 IN THE SPOTLIGHT
- 18 TRENDING NOW
- 27 REGULATORY ARENA
- 28 REVIEWS
- 41 AROUND THE COUNTRY
- 44 CHECKOUT



**EDITOR-IN-CHIEF** Michael T. Nickerson  
mtn620@mail.usask.ca

**EXECUTIVE EDITOR** Theresa Rogers  
trogers@dvtail.com

**ASSOCIATE EDITOR** Nicolas Heffernan  
nheffernan@dvtail.com

**MARKETING & COMMUNICATIONS, CIFST** Ann Manley  
amanley@cifst.ca

**CONTRIBUTORS** Richard A. Holley  
Michael Nickerson  
David Pink  
Marleny D.A. Saldana  
Feral Temelli  
Lu Ann Williams  
Sara Zborovski

**STAFF WRITER** Hermione Wilson  
hwilson@dvtail.com

**EDITORIAL INTERN** Michael Markov

**ART DIRECTOR** Katrina Teimourabadi  
kteimo@dvtail.com

**ADVERTISING SALES**

**SALES MANAGER** Beth Kukkonen  
bkukkonen@dvtail.com

**SENIOR ACCOUNT EXECUTIVE** Gillian Thomas  
gthomas@dvtail.com

**V.P. PRODUCTION SERVICES** Roberta Dick  
robertad@dvtail.com

**PRODUCTION MANAGER** Crystal Himes  
chimes@dvtail.com

**PRODUCTION CO-ORDINATOR** Joanna Forbes  
jforbes@dvtail.com

**DOVETAIL COMMUNICATIONS PRESIDENT** Susan A. Browne  
sbrowne@dvtail.com

**Editorial Advisory Council**  
Michael T. Nickerson, Ph.D., P.Ag.,  
*Editor-in-Chief*  
University of Saskatchewan

Dave Bender, *Vice President of Research & Development*  
Griffith Laboratories

Dr. Joyce I. Boye, AAFC

Professor Eunice C. Y. Li-Chan, PhD.  
University of British Columbia

Ann Manley, CIFST

H.P. Vasantha Rupasinghe, Ph.D.,  
Dalhousie University

Alphonsus Utioh, P.Eng.,  
Manitoba Food Development Centre

Sara Zborovski  
Partner with the Toronto office of  
Davis LLP

**Published by:**  
Dovetail Communications Inc.  
30 East Beaver Creek Rd., Suite 202,  
Richmond Hill, ON Canada L4B 1J2  
905-886-6640  
Toll-free 1-888-232-2881  
www.dvtail.com

**For:**  
Canadian Institute of Food Science and  
Technology  
3-1750 The Queensway Suite 1311  
Toronto, ON Canada M9C 5H5  
905-271-8338  
Fax: 905-271-8344  
www.cifst.ca

Copyright CIFST. All rights reserved. Contents may not be reproduced without written permission. Views expressed herein are those of the authors exclusively.





follow us  @CDNFood

---

NICOLAS HEFFERNAN

---

EDITOR FOR  
CANADIAN FOOD INSIGHTS

---

**I LOOK AT CANADIAN FOOD INSIGHTS A LITTLE BIT LIKE MY CHILD.**

Together with the amazing team at CIFST, I helped create it, nurture it and have watched it grow into the fantastic publication it is today.

Sadly, this will be my last issue. But what an issue this is to go out on. An industry trends story is always an interesting read. This year, industry research giant Innova Market Insights, gives us a glimpse of what's to come in this fast-changing industry. I find the snack trend particularly interesting. Whether because we are more pressed for time than ever, or we are heeding calls for smaller, more frequent and healthful meals, formal mealtimes are continuing to decline in popularity. Quick, healthy foods are replacing traditional meal occasions and more snacks are targeted at specific moments of consumption, with different demand influences at different times of day.

We also look at the potential impacts of Health Canada's new labelling requirements. Although it's in the early stages, it will be interesting to see how this process plays out over the next few months and years. Whether the new steps will benefit the industry is debatable but the innovative companies will find a way to get in front of this.

In my final article I talk to Bruce Roberts, Executive Director of the Canadian Poultry Research Council. The amount of innovation, with a focus on reduction of antibiotics, that's involved with the cluster, is really intriguing.

While this is the end for me, it's just the beginning for this great magazine. I'll always be watching how my child grows.

*Sincerely*

NICOLAS HEFFERNAN



## Connected. Unique. Innovative.

We know how our Canadian customers value having easy access to a local partner with a large portfolio of high quality, natural ingredients and flavours to create clean-label foods and beverages.

That's why Kerry's Canadian team is dedicated to understanding your challenges and goals in order to help you deliver delicious, on-trend consumer-preferred products.

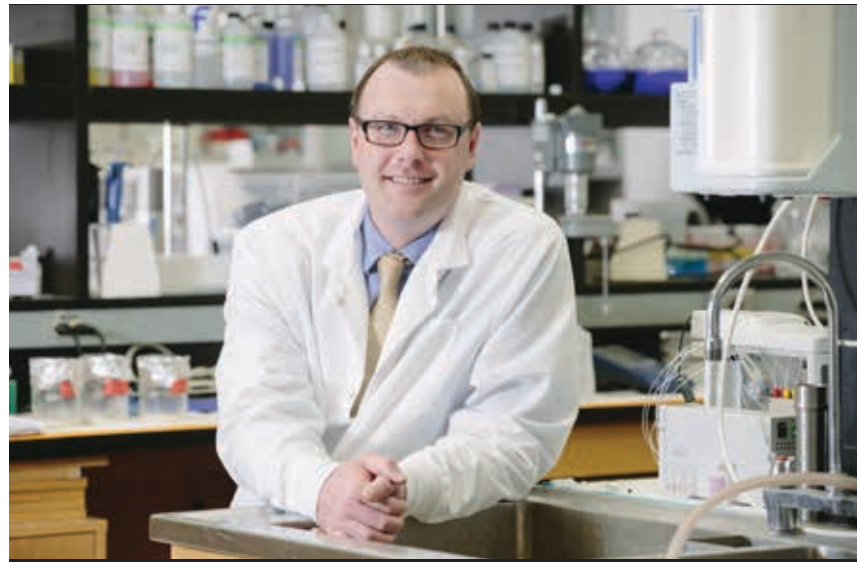
**Kerry**

555 Rutherford  
Granby, QC, J2G 3Z2 CANADA

[info.granby@kerry.com](mailto:info.granby@kerry.com)

1.888.578.0841 | [www.kerry.com](http://www.kerry.com)





**MICHAEL T. NICKERSON, PH.D., P.AG.**  
SASKATCHEWAN MINISTRY OF AGRICULTURE  
RESEARCH CHAIR  
*(Protein Quality and Utilization)*  
Department of Food and Bioproduct Sciences  
University of Saskatchewan

WELL, ANOTHER YEAR IS COMING TO A CLOSE for *Canadian Food Insights*, so we thought we'd end the year with a bang. This issue, *Canadian Food Insights* is bringing you three hot reviews in the area of food processing just in time for the holidays. One is entitled 'Food irradiation adds cost but makes sense', and describes the potential of using food irradiation to make our foods safe. In another entitled, 'Supercritical carbon dioxide technology for food and natural health products', the authors describe the potential of use supercritical fluids as a means for extracting and fractioning 'natural' ingredients for the functional food and natural health products industry. And finally, a review entitled, 'The role of physics in foods: modelling, computer simulation and things you probably knew about', highlights the potential benefits for food scientists joining forces with theoretical physicists to improve product formulations and optimizing processing to help improve product quality. Our Regulatory Arena section touches upon the use of the word, 'natural' from a regulatory and labelling standpoint.

The rest of the issue is filled with top trends in the food and beverage sector, and highlights successes across Canada. A special thanks to my entire team, from those on our Editorial Board to those at Dovetail Communications for continually making *Canadian Food Insights* possible. In particular, I wanted to take the time to especially thank Nicolas Heffernan, our Editor from Dovetail Communications, who is leaving us for new challenging endeavours, for his energy, interesting stories and vision for capturing important issues within Canada's food and beverage sector.

*Sincerely*  
MICHAEL T. NICKERSON

# Embassy Flavours

Customized Bakery Ingredients

## OUR MANUFACTURING CAPABILITIES INCLUDE:

- Full Range of Flavours & Bakery Ingredients
- Flavour Formulation
- Baking Product Design & Development
- Bakery Industry Specialization
- **Leading Gluten Free Technology**



1 800 334 3371 • sales@embassyflavours.com • embassyflavours.com

food  
EVENTS  
2015

Jan. 29-Feb. 1  
Guelph Organic  
Conference  
GUEPLH, ON

February 22-24  
Annual Meat  
Conference  
NASHVILLE, TN

February  
Beef Farmers of Ontario  
Annual Meeting  
TORONTO, ON

February 23-24  
Wild Oats  
Grainworld  
WINNIPEG, MB

February  
Canadian Federation of  
Agriculture Annual Meeting  
OTTAWA, ON

February 28-March 1  
Baking Industry Suppliers  
Association Winter Summit  
CHICAGO, IL

March 1-3  
Canadian Restaurants and  
Foodservices Trade Show  
TORONTO, ON

March 3-5  
Canola Council of  
Canada Convention  
BANFF, AB

## PEOPLE PROFILE

## Young Canadian activist brings GMO labelling to Parliament Hill

RACHEL PARENT MAY ONLY BE 15, BUT SHE'S ALREADY GETTING ATTENTION FROM CANADIAN HEALTH OFFICIALS

TEXT BY HERMIONE WILSON

YOU MAY HAVE HEARD OF RACHEL PARENT. The young activist's name has become synonymous with the mandatory GMO-labelling movement in Canada, especially since she met with Minister of Health, Rona Ambrose on Nov. 6, 2014.

"The Minister was very nice and approachable," Parent says. "She was very responsive to me and was really interested in seeing all my research and material." Ambrose, she says, was aware that polls have shown that 90 per cent of Canadians would like to see GMO foods labelled.

Parent's passionate activism was born when she did a speech at school on GMO foods. Her research led her to the conclusion that not enough had been done to investigate the safety of GMOs. At only 12 years of age, Parent started her own non-profit organization, Kids Right to Know, to raise awareness about the issue in Canada. "We need more independent long-term testing to determine its safety," Parent says, "and until [GMOs are] proven safe, we all have a right to know."

Now 15 years old, the Toronto native has debated with CBC personalities, given a TEDx talk and spoken at a variety of environmental activism events. Throughout, she has been persistent in her calls for GMO foods to be labelled in Canada.

"This is no longer a fringe or radical movement, it's becoming more and more mainstream and people are becoming more and more aware and concerned," Parent says. "I really hope that more people – and especially kids – will take action to push this issue until GMO labelling becomes a law."

After their meeting, Minister Ambrose announced at a press conference that she had arranged for Parent to make a presentation to Health Canada officials. But Parent won't be standing still until then; she's off to India to attend a workshop on Gandhi, Globalization and Earth, where she hopes to meet her hero, environmental activist Dr. Vandana Shiva. "She's just such an incredible role model, not just for the movement but for girls and women as well," Parent gushes. "I really hope to learn as much as I can from her."

This from a girl who is well on her way to becoming a role model herself.



## MAPLE LEAF HOSTS 6TH ANNUAL FOOD SAFETY SYMPOSIUM

Maple Leaf Foods recently hosted its Sixth Annual Food Safety Symposium. At the event, 170 representatives from more than 100 companies gathered to discuss the most pressing concerns in food safety. This year's event was themed "People or Technology", asking participants to debate which was the best investment to make a significant change in global food safety.

"Food safety incorporates a broad cross-section of people and technologies and so we adopted a deliberately provocative theme this year," said Dr. Randy Huffman, SVP Operations and Chief Food Safety Officer at Maple Leaf. "Everyone would choose 'both' to the question of investing in people versus technology, but in reality, resources are never unlimited and choices about investments, both large and small, are made each and every day. The provocative question we debated was which investment would lead to the greatest advancement?"

The symposium also gave participants the opportunity to learn more about the "Safe Food Canada – The Learning Partnership" model. While it is still not finalized, it aims to standardize food safety competencies, enable workers in the Canadian food industry to progress and grow in the profession, and improve Canada's food safety performance.

## Researchers Challenge Common Views on Saturated Fat, Sodium and Sugar

RESEARCHERS ARE CHALLENGING THE WAY CANADIANS THINK ABOUT SATURATED FAT, SODIUM, AND SUGAR, and are ready to explore the pitfalls posed by the nutrient-focused approach used in dietary guidelines. This took place at a series of cross-Canada symposia titled "Straight Talk about Nutrition Guidelines" held in Vancouver, Toronto, Montreal, and Moncton in November and organized by the Registered Dietitians at Dairy Farmers of Canada.

Traditionally, nutrition recommendations and guidelines have been based on studies largely focused on the effect of specific nutrients on specific risk factors such as LDL-cholesterol or blood pressure, as opposed to looking at the impact of whole foods on actual disease risks. However, this approach to dietary guidelines has largely ignored the true impact on actual health of nutrients, and more importantly real, whole foods.

Research is making it increasingly clear that we need a more food-based approach in our nutrition recommendations that takes into account the true impact of foods on overall health. "With this large growing body of evidence, we, as health professionals, need to be aware of this new data and information which may challenge some of our views," said Isabelle Neiderer, registered dietitian and Director, Nutrition with Dairy Farmers of Canada. "This is becoming particularly apparent in the areas pertaining to saturated fat and sodium where a growing body of research is questioning some of our assumptions."



Photo credits: www.uwaterloo.ca

## EGG FARMERS OF CANADA PARTNERS WITH THE UNIVERSITY OF WATERLOO

Egg Farmers of Canada announced a new partnership with the University of Waterloo, establishing Bruce Muirhead as the industry's first-ever research chair in public policy.

"We are delighted to be working with Professor Muirhead," said Tim Lambert, Chief Executive Officer of Egg Farmers of Canada. "With the creation of this Chair, we hope to continually elevate the caliber of the dialogue on supply management and ensure that any future policy decisions that could affect supply managed commodities are as informed as possible."

Muirhead will develop a research program that relates to the current and future challenges faced by Canadian egg farmers, providing historical context to the growing conversation about the value of supply management for all Canadians.

"This Chair will allow me to fully engage in the discourse surrounding supply management and its obvious benefits to Canadian consumers and processors, as well as farmers," said Muirhead. "This approach is increasingly important given Canadian involvement in various trade negotiations where supply management needs to be understood for its value and benefits to the entire food chain."

Egg Farmers of Canada's contribution to the University of Waterloo will serve these goals by investing in students, research, and dialogue around public policy issues.

food  
EVENTS  
2015

March 5-6

Annual North American  
Food Safety Summit

TORONTO, ON

March 10-12

Canadian Horticultural  
Council General Meeting

QUEBEC CITY, QC

March 23-26

International  
Pizza Expo

LAS VEGAS, NV

April 9-12

Canada Health Food  
Association Expo

VANCOUVER, BC

April 10-12

Good Food and  
Drink Festival

TORONTO, ON

April 15-17

Canada Produce Marketing  
Association Convention

MONTREAL, QC

May 31-June 1

Bakery Congress Trade Show  
Conference and Trade Show

MONTREAL, QC

June 15-17

Canada Poultry and Egg  
Processors Council Convention

TORONTO, ON

COMPANY PROFILE

No  
Ordinary  
Sap



MAPLE WATER OVERCAME COMPETITION FROM EUROPE AND THE UNITED STATES to finish first at the recent 2014 Global Bottled Water Congress (GBWC).

KiKi Maple Sweet Water was recognized as the top new product at the congress, which took place in Budapest, Hungary. The beverage is made with Ontario maple sap produced by manufacturer Troll Bridge Creek Inc. (TBCI). “We are very pleased with this outstanding recognition,” said Keith Harris, Chief Executive Officer of TBCI. “Being first in the market and with the longest track record, this is further acknowledgement of the leading position KiKi Maple Sweet Water has in the market.”

The 11th Global Bottled Water Congress hosted industry leaders, suppliers, customers and analysts from around the globe. KiKi Maple Sweet Water is hoping the award will help build its new market segment.

“Keith Harris made a very compelling case for KiKi Maple Water at the 2014 Global Bottled Water Congress,” said William Anderson, Founder and CEO of First Beverage Group and one of the judges in the GBWC shoot-out. “Keith explained why the category is now gaining significant traction and how large the category can become. It was also great to taste all four SKUs – he’s done a terrific job on the liquid.”

KiKi Maple Sweet Water beat off keen competition for delegate votes at the Congress. “Up against a new functional water and a breakthrough packaging concept, delegates recognized the potential for a natural maple sap drink, even though it is not strictly a water at all,” commented Congress organizer and Chairman of Zenith International, Richard Hall. “For many of them, it was the first time they had studied the niche in detail. They also found the taste unexpectedly mild and light.”

AGRI-FOOD SECTOR  
POISED TO FEED  
EMERGING MARKETS

Canada’s agriculture and food sector can safely be labeled “Old Faithful” for its contribution to Canada’s export-based economy. While not a flashy industry, it remains among the most dependable and consistent in terms of foreign sales year after year.

Export Development Canada’s latest forecast called for foreign shipments, which totaled more than \$50 billion in 2013 and represented 9.5 per cent of all Canadian exports, to increase 10 per cent in 2014 and another five per cent in 2015, both all-time highs.

Daniel Benatuil, an economist at EDC specializing in agri-food exports, notes that the sector outperformed many others during the recession and has bounced back strongly since. “We are at the mercy of global trends in terms of exports because Canada is a significant agri-food producer that consumes less than it produces, but fortunately most of those trends are positive for Canada,” he said. The outlook going forward remains positive for most agri-foods Canada exports including oilseeds, pulses, wheat, manufactured food and beverages, meats, live animals, and seafood.

FOREIGN SHIPMENTS IN 2013  
TOTALLED  
\$50 BILLION



Leading the Way on Raw  
Food Safety

Raw food, like edible seeds such as chia, hemp, flax, and sesame, boasts a broad range of health benefits and are growing in popularity. However, many consumers are unaware that raw unprocessed foods, such as seeds, may not be safe due to contamination by pathogens like E. Coli or Salmonella. This can have devastating effects on the health of consumers, but also on retailers and wholesalers selling raw products.

Both the CFIA and the FDA have concluded that in 2014 alone, more than 100 Canadians and Americans suffered severe illnesses from eating contaminated food products made from raw edible seeds. In an effort to solve this growing problem, the Canadian company Agri-Neo has launched Neo-Pure, the first CFIA-approved organic sanitizer that destroys harmful pathogens like bacteria and fungi on the surface and inside of raw edible seeds.

“This is a major advancement – it gives confidence to consumers that raw edible seeds, which we know have so many health benefits, are as pure as they can be,” said Rob Wong, President and CEO of Agri-Neo. The *Safe Food for Canadians Act* and the *Food Safety Modernization Act* in the U.S. both prescribe this preventative treatment for pathogen control.



GENETIC TESTING FOR PERSONALIZED NUTRITION  
LEADS TO BETTER OUTCOMES

Personalized dietary advice based on a person’s genetic makeup improves eating habits compared to current “one-size-fits-all” dietary recommendations, says a University of Toronto researcher.

“We conducted the first randomized, controlled trial to determine the impact of disclosing DNA-based dietary advice on eating habits,” said Ahmed El-Sohemy, an associate professor in nutritional sciences and Canada Research Chair in Nutrigenomics. “We found that people who receive DNA-based advice improve their diet to a greater extent than those who receive the standard dietary advice.”

Nutrigenomics is a field of research that aims to understand why some people respond differently than others to the same foods. Personalized nutrition, a branch of personalized medicine, is an application of nutrigenomics that helps tailor dietary recommendations to a person’s DNA.

The researchers collected data on the intake of caffeine, sodium,

vitamin C and sugar from 138 healthy young adults. The subjects were then randomized into two different study groups – one was given DNA-based dietary advice for each of the four dietary components of interest, and the other group was given current standard dietary advice for the same dietary components with no genetic information.

Changes in their dietary habits were assessed after three and 12 months. The researchers found that subjects who received DNA-based dietary advice started to show improvements to their diets after three months and the changes became even more apparent after 12 months. Specifically, those who were informed that they carried a version of a gene linked to salt intake and high blood pressure significantly reduced their sodium intake, in accordance with the recommendation, compared to the group that was not given genetic information and received the standard advice for sodium intake.



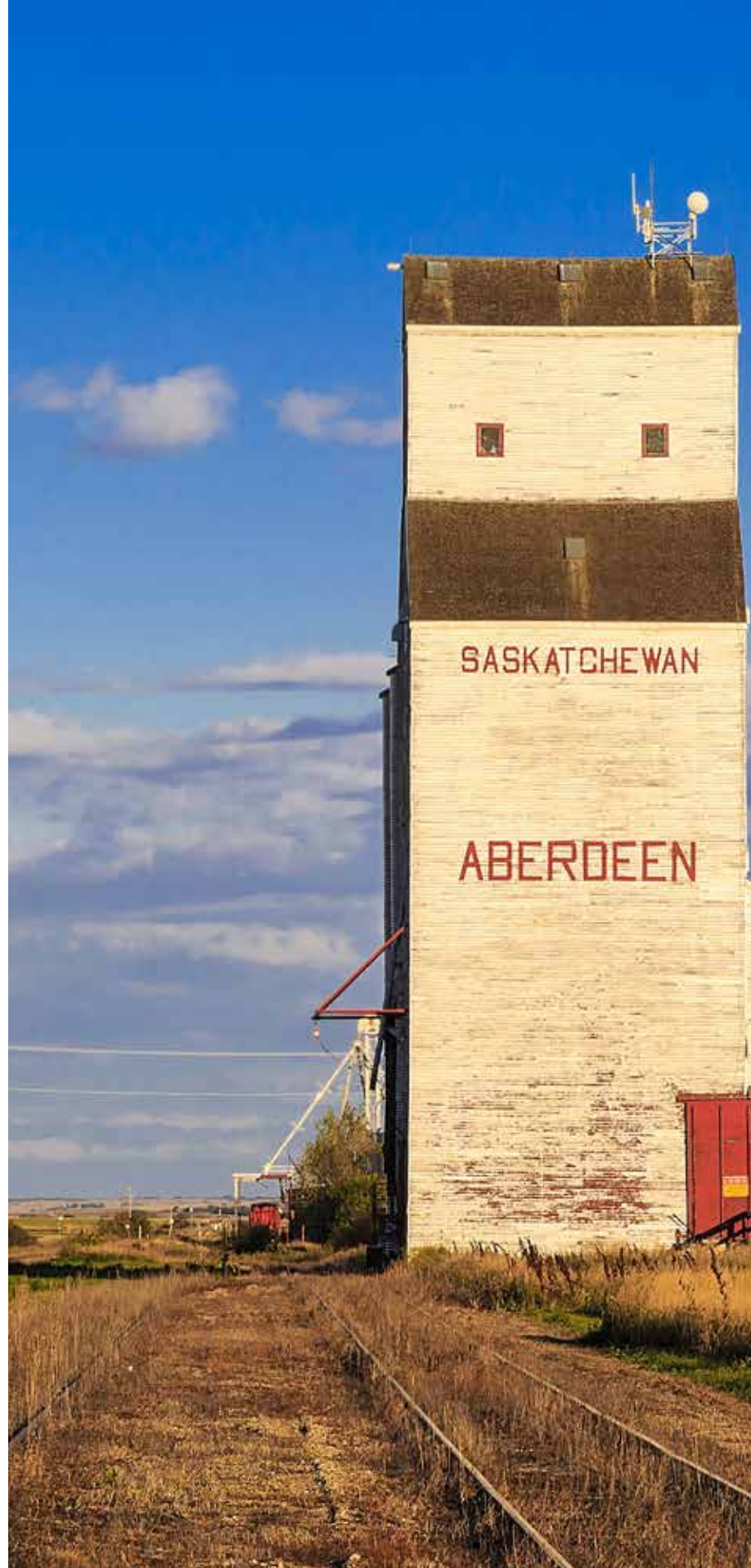
# BREADBASKET CONFIDENTIAL

SASKATCHEWAN'S DEPUTY MINISTER OF AGRICULTURE  
TALKS LENTILS, INTERNATIONAL PARTNERSHIPS AND  
THE MAGIC OF RESEARCH

TEXT BY HERMIONE WILSON

## THERE'S MORE TO SASKATCHEWAN THAN BREAD.

"We're sometimes known for our branded products," says Alanna Koch, Saskatchewan's Deputy Minister of Agriculture, "but the other thing we're known for is ingredients, high quality ingredients." Companies like InfraReady Products market Saskatchewan cereal grains, pulses and seeds as ingredient packages to international food processors who then bake and sell the finished products under their own label.



Saskatchewan has also seen advancements in its pulse crop production. The province produces 96 per cent of Canada's lentils and is the world's largest exporter of lentils and chickpeas. As a result, Saskatchewan has become one of India's largest trading partners, where chickpeas and lentils are a main feature in the local diet. During a February 2014 trade mission, Saskatchewan's Minister of Agriculture organized events promoting Saskatchewan-grown pulses and canola products in India, United Arab Emirates (UAE) and Morocco.

The province has put in place programs like the Saskatchewan Market Development Program, the Saskatchewan Food Industry Development Centre, and the Saskatchewan Agri-Value Initiative (SAVI) to assist manufacturers in developing and marketing products that use locally grown ingredients. Manufacturers like CanMar Grain Products which, with funding from the Market Development Program, are taking advantage of the fact that Saskatchewan grows 82 per cent of Canada's flaxseed with their Omega 3-rich roasted flaxseed product.

Seasonal produce like vegetable crops aren't a major focus for Saskatchewan, given its cold climate. Still, in the last few years, select pockets of the province have seen an increase in this type of crop production. "We have seen a small greenhouse sector start to take advantage of our many hours of sunshine," says Koch. "They are producing crops like onions, carrots, cucumbers and tomatoes, and they've got an affiliation with some of the co-op stores in Saskatchewan."

Locally grown produce will always be niche, says Koch. Wheat is still a major player in the Saskatchewan agricultural sector. The province's food science and agricultural research efforts are currently focused on adding value to wheat products, increasing yields, improving quality and fortifying crops against insects and disease. Premier Brad Wall announced a \$10 million investment in wheat at the 2012 Saskatchewan Agricultural Wheat Summit.





Omega 3-rich flaxseed grows in Saskatchewan.

THE SASKATCHEWAN MINISTRY OF  
AGRICULTURE SPENDS  
**\$26.7 MILLION**  
ON RESEARCH ANNUALLY

**CHICKPEAS  
AND LENTILS**  
HAVE BECOME SASKATCHEWAN'S LARGEST  
TRADING RESOURCE WITH INDIA

SASKATCHEWAN GROWS  
**82%** OF CANADA'S FLAXSEED

THE PROVINCE PLANS TO INCREASE  
CROP PRODUCTION TO  
**36 MILLION**  
TONNES BY 2020

"We're now sitting at \$26.7 million coming out of the Saskatchewan Ministry of Agriculture in research on an annual basis," says Koch. "Our research investment has doubled since 2007." Still, she says, public dollars won't be enough to fund all the research that's needed in the sector. In order to generate more capital, the Ministry of Agriculture recently put out a call for proposals for new and innovative ways to produce and improve wheat production, which comes to an end in January 2015. The key to success, says Koch, will be public-private partnerships.

"The partners need to come to the table with a public partner and a private partner, and they both need to demonstrate that they've leveraged each other and worked together to see advancements in wheat that can then, hopefully, be commercialized."

Food science and agricultural research, most of which is centered at the University of Saskatchewan, has long been a major fixture in the province. The Ministry of Agriculture has partnered with a number of private investors and publically funded groups to contribute to global food security and boost the province's agricultural sector.

"At the Crop Development Centre, which we have been funding for many years, we have seen over 400 crop varieties come out and be commercialized," says Koch. "That's where we think the magic is in research. Not just having all this great investment going in, but actually seeing it come out the other end and be commercialized."

In Saskatchewan's plans for growth, the province has set a series of agricultural goals, says Koch. The province wants to increase crop production to 36 million tonnes by 2020, take advantage of a large land base to increase livestock opportunities, and further develop the value-added ingredient industry. "We're always going to be a giant in crop production," Koch says. "That's where we'll make the most of what Saskatchewan has to offer." ■



Thinking  
beyond  
ingredients.



After 54 years of supplying quality ingredients from the world's finest Principals to clients in the Food Sector, we invite you to experience the Lomas Technical Center. The concept is simple: To add value for our clients by inviting them on a journey of discovery and invention. Part kitchen, part laboratory and part education nexus, the Technical Center is where our people work with yours, where imagination and possibility can create ingenious new products and opportunities.

**Call to receive our FREE Technical Symposium  
schedule of events.**



Discover the wonderful world of possibilities at [lvolomas.com](http://lvolomas.com) or contact us at **1 800 575 3382**

BY LU ANN WILLIAMS, DIRECTOR OF  
INNOVATION AT INNOVA MARKET INSIGHTS

INNOVA MARKET INSIGHTS RECENTLY IDENTIFIED ITS TOP 10 TRENDS LIKELY TO IMPACT THE FOOD INDUSTRY IN 2015 AND BEYOND, identified by the company's ongoing analysis of key global developments in food and drink launch activity worldwide. In previous years, Innova has consistently predicted upcoming trends, including "Sustainability" in 2008, "Free-From Rises" in 2010, "Return to Softer Claims" in 2011, and "Location, Location, Location" in 2012, all of which have developed further and continue to have a significant effect on the industry today.

This year, the company is predicting the rise of the clear label.

"The move from 'clean' to 'clear' labelling is a key trend for 2015, reflecting a move to clearer and simpler claims and packaging for maximum transparency," says Lu Ann Williams, Director of Innovation at Innova Market Insights. "Meeting the needs of the Millennial consumer has also become a key focus, as has targeting the demands of the gourmet consumer at home, re-engineering the snacks market for today's lifestyles and combating obesity with a focus on positive nutrition."

#### TOP FOOD AND BEVERAGE TRENDS FOR 2015 ARE:

##### FROM CLEAN TO CLEAR LABEL

Clean label claims are tracked on nearly a quarter of all food and beverage launches, with manufacturers increasingly highlighting the naturalness and origin of their products. With growing concerns over the lack of a definition of "natural," however, there is a need for more clarity and specific details. Consumers, retailers, industry and regulators are all driving more transparency in labelling.

##### CONVENIENCE FOR FOODIES

Continued interest in home cooking has been driven by cooking shows on TV and by blogging foodies. It is seen as fashionable, fun and social, as well as healthy and cost-effective. It has driven demand for a greater choice of fresh foods, ingredients for cooking from scratch and a wider use of recipe suggestions by manufacturers and retailers.

“ THE MOVE FROM ‘CLEAN’ TO ‘CLEAR’ LABELLING IS A KEY TREND FOR 2015, REFLECTING A MOVE TO CLEARER AND SIMPLER CLAIMS AND PACKAGING FOR MAXIMUM TRANSPARENCY. ”

– LU ANN WILLIAMS, DIRECTOR OF INNOVATION AT INNOVA MARKET INSIGHTS



CONTINUED INTEREST  
IN HOME COOKING HAS  
BEEN DRIVEN BY  
**COOKING SHOWS  
ON TV AND  
BY BLOGGING  
FOODIES.**  
IT IS SEEN AS  
FASHIONABLE, FUN AND  
SOCIAL, AS  
WELL AS HEALTHY AND  
COST-EFFECTIVE.

### MARKETING TO MILLENNIALS

The so-called Millennial generation, generally aged between 15 and 35, now accounts for about one-third of the global population and is tech-savvy and socially engaged. They are well informed, want to try something different and are generally less brand loyal than older consumers. They want to connect with products and brands and know the story behind them.

### SNACKS RISE TO THE OCCASION

Formal mealtimes are continuing to decline in popularity and growing numbers of foods and drinks are now considered to be snacks. Quick healthy foods are tending to replace traditional meal occasions and more snacks are targeted at specific moments of consumption, with different demand influences at different times of day.

### GOOD FATS, GOOD CARBS

With concerns over obesity there is a growing emphasis on unsaturated and natural fats and oils that has seen rising interest in Omega-3 fatty acid content as well as the return of butter to favour as a natural, tasty alternative to artificial margarines that may be high in trans fats. In the same way, naturally occurring sugar is being favoured at the expense of added sugars and artificial sweeteners.

### MORE IN STORE FOR PROTEIN

Ingredient suppliers, food producers and consumers are on the lookout for the next protein source. Soy protein is regarded as cheap and mainstream and therefore being less applied among NPLs tracked. Whey protein has been popular for some years and is still growing, while pulse protein is rapidly emerging. More algae protein applications are expected in the future. Further along, insect protein may become big in various categories. Damhart Nutrition recently launched the Insecta range to Belgian supermarkets; a line of burgers, schnitzels and nuggets, all created using Dutch-bred buffalo worms. The buffalo worms reared specifically for human consumption are applied as an alternative high protein, meat substitute.

### NEW ROUTES FOR FRUIT

More product launches are being tracked with real fruit and vegetables, as they can function as colouring foodstuffs and in that role meet the increased demand for natural colours and flavours. Fruit and vegetable inclusions can add to the “permissible indulgence” character of a product. Consumers perceive a product



*Soy is just one source of protein experiencing growth as producers and consumers look to new sources.*

*The frozen food segment is experiencing a revitalization with lots of product launches.*

to be healthier when it contains a real fruit or vegetable ingredient. Recent launches include Food For Health Kids Little Bites Choco Banana (Australia), which is “made with real fruit.”

### A FRESH LOOK AT FROZEN

In order to compete with the healthy appeal of fresh aisles and the convenience of canned foods, established frozen foods (vegetables and seafood) are focusing on freshness in their marketing, stressing the superior nutritional content in frozen food. Brand extensions include larger varieties in vegetables and fruits. At the same time, the frozen segment is witnessing new product launch activity in new categories (e.g. soups, fruit, drinks, finger foods, sauces, pastries, herbs). Findus now offers a line of frozen Mediterranean Spices that offer high convenience and fresh qualities.


### PRIVATE LABEL POWERS ON

Even though the worst of the economic recession is over, private label is still gaining market share in terms of new product launches in Europe, North America and Australasia. Store brands are here to stay and are found in all product segments. Discounters Aldi and Lidl are by consumers no longer solely seen as budget stores, but are accepted by the general public and considered to have good quality products. Recent innovations from retailers include M&S Summer of Flavour Cream Cheese With Wasabi.


*The so-called Millennial generation, generally aged between 15 and 35, now accounts for about one-third of the global population and is tech-savvy and socially engaged.*

### RICH, CHEWY & CRUNCH

Texture is an important driver for taste perception of food and beverages and focus of many of today’s food innovations. Brands are creatively combining textures with for example crispy inclusions, soft centres and extra crunchy toppings. Texture claims are shown more prominently on front-of-pack. Also, brands are creative in describing texture or including a texture claim in a product name. Recent innovations include Quaker Big Chewy Chocolate Chip bars. ■



## FlavourSpec® - Sensitive VOC analysis without sample Pre-Treatment



*Gas-Chromatograph coupled to  
Ion-Mobility-Spectrometer*

**Highlights:**

- Sensitive VOC-Detection (ppb-/µg/L- range) directly from headspace
- 2-dimensional separation of complex mixtures/flavours
- **No sample pre-treatment / no solvent extraction necessary**
- Easy to use (*colleague-to-colleague*)
- High sample-throughput (*inject-to-inject typically <20 min.*)
- Support of compound identification based on NIST2014 RI-Library
- High reproducibility through physical working principle of GC plus IMS

**Applications:**

- Raw material and finished product quality control
- Impartial flavour documentation
- Monitoring of product aging
- Sensitive detection of off-smells
- Support of sensory panels (authentication, blending etc)

G.A.S. Gesellschaft für analytische Sensorsysteme mbH / Otto-Hahn-Str. 15 / 44227 Dortmund, Germany  
Tel.: +49 231 9742-6550, e-mail: [info@gas-dortmund.de](mailto:info@gas-dortmund.de), website: [www.gas-dortmund.de](http://www.gas-dortmund.de)



"As a distribution company, our success can only be achieved by the development and maintenance of a strong working relationship with our **Product Partners.**"  
(Al Frittenburg, CEO)



Flavours  
Flavour Systems:  
Salt, Sugar, Fat Reduction



BBQ Sauces  
Hot Sauces  
Mustards  
Spray-Dried Powders



Gelatine  
Collagen Peptides (pure protein)  
Synergy Systems (Gelatine Systems)



Fresh Frozen Culinary Herbs  
SupHerb Farms Fusions®  
Blends, Pastes and Purées



Natural Fruit & Vegetable Powders,  
Vegetable Juice Concentrates,  
Wine Concentrates & Powders,  
Seafood Powders



Freeze Dried Mushrooms



Spice Extracts  
Oxidation Management  
Natural Colours



Tomato Powder



Pre-cooked Dehydrated:  
Beans, Peas and Lentils



# LABELL MAKEOVER

NUTRITION LABELS ON GROCERY STORE ITEMS MAY SOON CHANGE. IMPACT TO INDUSTRY WILL BE MAJOR BUT WILL THE IMPACT TO CONSUMERS FOLLOW SUIT?

TEXT BY HERMIONE WILSON

[www.theingredientcompany.com](http://www.theingredientcompany.com)

THE NUTRITION FACTS TABLE ON FOOD ITEMS IN THE GROCERY STORE MAY SOON LOOK VERY DIFFERENT, resembling nutrition labels in the United States. Health Canada, which proposed these changes to the current table, says the goal is to “provide Canadians with the nutrition information they need to make informed decisions about the foods they buy.”

The new table gives more prominence to a product’s caloric content, groups the ingredients of concern like fats and sodium together, and separates them from beneficial ingredients like fibre and protein. It also gives consumers the Daily Value percentage for each ingredient and ensures that portion sizes adhere to standard amounts that reflect actual consumption habits. On Nov. 14, 2014, Health Canada announced another addition to the labelling requirements: it would allow specially produced oats and foods containing these oats to use the “gluten-free” health claim.

It all began with a commitment the government of Canada made in the 2013 Speech from the Throne to “consult with Canadian parents to improve the way nutritional information is presented on food labels.” Health Canada began a series of consultations in January 2014. According to the feedback received, Health Canada proposed changes to the Nutrition Facts table and in July of 2014, opened those changes up for public discussion. Once a report on the feedback

from this most recent round of consultations is finalized, “the next step would be to revise, if necessary, any of the proposed changes,” says Health Canada spokesperson Gary Holub.

“We then would proceed to putting those changes into some sort of regulatory amendment, if indeed regulatory amendments were required. Then it’s a parliamentary process and another public consultation will have to take place. It’s going to be a while.”

For the most, part the food industry seems to support the intent behind Health Canada’s proposed changes, but some have expressed concerns as to whether those changes are supported by adequate scientific data. The Food and Consumer Products of Canada (FCPC) association, which represents the Canadian food, beverage and consumer products industry, is calling for more scientific research to be done to ensure that the proposed changes have

the desired effect on consumer education and overall health.

“We think that there is a real opportunity to increase the use and awareness of the Nutrition Facts table, but at this point there isn’t enough information to know the impacts that the changes are going to have on the consumer,” says FCPC spokesperson Adam Grachnik. “They’re the most significant changes really ever to the Nutrition Facts table. They will have major, major impacts on the industry.”

#### BRAVE NEW LABEL

Health Canada’s proposed changes to the Nutrition Facts table may not have a big impact on consumers beyond the fact that it will be easier for them to read and may lead to healthier shopping habits, but for the food industry, the change would require some major adjustments in the way they label and even formulate their products.

“Anytime you make changes to a label there is a cost factor involved,” says Phyllis Tanaka, a registered dietician and senior advisor to FCPC. “That said, the food manufacturing industry,

*For the most, part the food industry seems to support the intent behind Health Canada’s proposed changes, but some have expressed concerns as to whether those changes are supported by adequate scientific data.*

and in particular FCPC members, are what I’d call champions of the Nutrition Facts table as an education tool for consumers,” she says. FCPC has been working with Health Canada over the last few years to educate Canadians about how to use the current nutrition label, Tanaka adds.

It was in 2003 that manufacturers of prepackaged foods were first required to label their products with the current Nutrition Facts Table. “The review process doesn’t happen bi-annually and it probably won’t happen again for a number of years,” Tanaka says. “We want to make sure that the changes that come forward at the end of the day provide science-based information in a format that allows Canadians to use it as a tool to make informed decisions.”

The changes to the nutrition label could bring more clarity for consumers, says Marie-Claude Mallet, Nutrition Manager at the Heart and Stroke Foundation, “But Health Canada will

#### Proposed changes to the Nutrition Facts Table

Move calories up, bold and increase font size

Remove thin line between Fat and Saturated

Nutrients of public health concern to limit have a %DV and are above the thick line

Nutrients of public health concern to get enough of a %DV and are below the thick line

Add footnote explaining how to use %DV

Nutrition Facts		Valeur nutritive	
Per 3/4 cup (175 g) / par 3/4 tasse (175 g)			
<b>Calories 170</b>		% Daily Value (DV)* % valeur quotidienne (VQ)	
<b>Fat / Lipides</b> 5 g			<b>1 %</b>
Saturated / saturés 3.5 g			<b>18 %</b>
Trans / trans 0.2 g			<b>10 %</b>
<b>Cholesterol / Cholestérol</b> 20 mg			
<b>Sodium / Sodium</b> 450 mg <b>20 %</b>			
<b>Carbohydrate / Glucides</b> 23 g			
Total Sugars / Sucres totaux 18 g			<b>18 %</b>
Added Sugars / Sucres ajoutés 12 g			
<b>Fibre / Fibres</b> 0 g			
<b>Protein / Protéines</b> 7 g			
Vitamin D / Vitamine D 1.3 µg			<b>9 %</b>
Calcium / Calcium 220 mg			<b>17 %</b>
Iron / Fer 2 mg			<b>10 %</b>
Potassium / Potassium 150 mg			<b>4 %</b>

- ← Right justify Serving Size
- ← Add asterisk referring to footnote
- ← Add thick lines (3x)
- ← Separate DV's for trans and saturated fat
- ← Updated Daily Values
- ← Have a %DV for total sugars
- ← Add a declaration for "added sugars"
- ← Add absolute amounts for vitamins/minerals; Remove Vitamin A and C, add Vitamin D and Potassium

need to do a large consumer education campaign if everything is accepted.”

Although she calls FCPC industry members “champions of the Nutrition Facts Table,” Tanaka questions the need for these changes. “In Minister Ambrose’s survey of consumers, there was no bone of contention around the list of ingredients as it’s done now,” she says. “In fact, consumers understand how it’s done and found it useful. I’m not sure that these changes are going to be seen as an improvement.”

#### SPOTLIGHT ON SUGAR

In the proposed changes to the nutrition information requirements, added sugars will be grouped together in the Nutritional Facts table and given a total DV of 100 grams, as well as being grouped together in the ingredients list, with individual types of sugar, such as molasses and brown sugar, identified in parentheses. Carol Zweep, Manager of Packaging and Food Labelling Services at the Guelph Food Technology Centre, questions the wisdom of this change. It doesn’t make sense to say that a natural sugar is better than you intentionally adding that same sugar to a food product, Zweep says. “Take fruit concentrate, for example,” she says. “If you eat a fruit – and a dried fruit has lots of sugar in it – is that sugar any better than taking the concentrate and adding that sugar in as a sweetening agent?” Zweep asks.

The Heart and Stroke Foundation applauds the addition of the Daily Value percentage for

added sugar, Mallet says, but worries consumers will confuse added natural sugars and added artificial sweeteners. “We want to make sure that people will not limit their consumption of fruits and vegetables based on total sugar, because those foods contain good sugars,” Mallet says.

It will be a complex process for manufacturers to recalculate and possibly adjust the sugar content in their products now that they have been grouped together, Zweep says. “By lab analysis you won’t be able to determine what’s been added and what’s natural sugar; it’ll just come out as sugar,” Zweep says. “To calculate what you’ve added and put that as a separate line, it’s not impossible but it’s a lot of work.”

“Why would you take just one group of nutrients and gather them together, and not do it with other nutrients?” Tanaka says. “There’s no consistency in that proposal.”

At the end of the day, she says, the industry walks a fine line between satisfying the consumer’s desire to moderate their intake of certain ingredients and creating a product that adheres to the consumer’s expectation of taste. Companies looking to limit the sugar content of their products could find themselves running into the same problem they did with salt a few years ago. “We went through this whole development with salt,” says Zweep. “Manufacturers were starting to formulate foods with less salt, but they weren’t tasting very good and consumers didn’t buy them. It just sort of fell off the map.” The low sales

MANUFACTURERS OF PREPACKAGED FOODS WERE FIRST REQUIRED TO LABEL THEIR PRODUCTS WITH THE CURRENT NUTRITION FACTS TABLE BACK IN 2003





of Campbell Soup's low sodium soup options were a testament to this seeming contradiction between consumers' health concerns and their buying habits, Zweep says. "There are still going to be people interested in low sodium, but will it be enough?" she asks.

### Consumers are driving label reform based on what they believe to be the benefits and dangers of the foods they eat

#### MODERNIZING MAKEOVER

"Health Canada is undertaking what I've been calling a modernizing makeover," says Sara Zborovski, a Toronto-based lawyer who assists companies in complying with the regulatory requirements of the Food and Drugs Act. Part of that modernization is a revamping of the inspection system under the Safe Food For Canadians Act, Zborovski says. Another aspect of the makeover is the regulatory modernization. "Health Canada is looking at all of their regulations which were all promulgated at different times, which means that they have overlapping and sometimes inconsistent requirements, especially around labelling," she says. "They're basically doing a big clean-up and as part of that they're looking at market access issues, definition issues, composition issues."

There is no doubt that the proposed changes have a political aspect to them. They bring

Canada's labelling requirements in line with our neighbours to the south and serve as a signal to voters that the government and Health Canada are listening to growing concerns about nutrition and health. Still, the underlying movement among consumers towards greater awareness of what they consume is very real.

"Consumers really are wanting to understand what they're ingesting," said Kathy Perrotta, VP Ipsos Reid, in a presentation at the recent Food Innovation and Marketing Forum in Toronto. In previewing Ipsos's Canada Chats 2014 report on consumer behaviours, Perrotta noted that consumers are reading nutrition labels more than ever before. They are paying attention to ingredients of concern like sugar and sodium, and closely watching their caloric intake. "Doing things in moderation is a high priority for consumers," she said.

Speaking of trends in consumer behaviour, there is growing concern about GMO foods and whether they should be labelled in the grocery store. Some manufacturers already label their foods as non-GMO as an incentive to consumers, but there is no regulated system investigating those claims, just a personal commitment one company makes with its clients. That could soon change, says Zborovski.

"The consensus [about GMOs] in the industry is that this might be here to stay, whether or not we agree with it," she says. "Whether not Health Canada agrees that there is a safety concern,

which at present it doesn't, the movement is being largely driven by our trading partners in Europe and the U.S." In the near future, the Canadian food industry may not have a choice about labelling GMO foods if they want to continue exporting their products.

Consumers are driving label reform based on what they believe to be the benefits and dangers of the foods they eat, Zborovski says. Those beliefs are not always grounded in scientific evidence, but they do represent a growing awareness of nutritional issues.

"Right now we're hearing a lot about sugar, fat, sodium. All those things are bad for us. GMOs are apparently bad for us, non-organic food is bad for us," she says. "If industry is going to reformulate all of their products and redo all of their packaging to comply with what consumers want today, there's nothing to say that those trends won't shift in the future." ■

# Natural Label Claims

SARA ZBOROVSKI



IN RECENT YEARS, AN ENORMOUS AMOUNT OF ATTENTION HAS BEEN PAID TO FOOD LABELS. We know that Health Canada is looking at labels as it modernizes our food labeling system. We also know that

consumers are looking at labels; all food trend forecasting tells us that consumers are more interested than ever with how food is made and where ingredients come from.

Most recently, consumers are telling industry they want foods that are wholesome, authentic and "natural". And industry is listening and responding; the number of natural label claims has substantially increased in recent years.

The problem: there is no clear sense of what it means for a food to be "natural". The term is not defined in regulation, and while regulatory agencies have provided some guidance, a fair amount of uncertainty remains. Uncertainty is never good for business, and we have seen the implications of this uncertainty through regulatory actions and (primarily in the U.S.) food label-based litigation.

#### DEFINING "NATURAL"

The Canadian Food Inspection Agency (CFIA) has issued guidance to industry on the use of natural and, more specifically, on how the prohibition against false and misleading labeling and advertising will apply in the case of natural claims. The guidelines stipulate that foods or food ingredients that have been subjected to processes resulting in a significant altering of chemical, physical or biological state should not be described as natural. According to the CFIA, "natural" can generally be understood in Canada to mean:

- A food or ingredient that does not contain an added vitamin, mineral nutrient, artificial flavouring agent, or food additive;
- A food or ingredient that has not had any constituent or faction removed or significantly changed (except removal of water); and/or
- A food or ingredient that has been produced through the ordinary course of nature without the interference or influence of humans.

In general, the CFIA will not object to "natural" claims provided they are factual and not misleading.

In the U.S., the Food and Drug Administration (FDA) has

claimed that it is difficult from a food science perspective to define a food product that is "natural" because most foods have been processed and are no longer the product of the earth. The FDA has not developed guidance for use of the term natural or its derivatives, however has stated "it has not objected to the use of the term if the food does not contain added color, artificial flavors, or synthetic substances."

#### IMPLICATIONS FOR INDUSTRY

Armed with these ambiguous parameters around the use of the term "natural", and facing increasing calls from consumers for more natural foods, industry has had to make some difficult decisions. The result: food is being labeled as natural when that might not be entirely accurate.

In the U.S., mislabeled food can trigger the issuance of a warning letter and possibly a recall by the FDA. The U.S. competition watchdog (the Federal Trade Commission, or FTC) has played an active role in policing the food industry, issuing numerous complaints against food companies for mislabeled products. In addition, U.S. litigators have focused their attention on the food industry, and class action lawsuits that allege consumers are being misled by all-natural claims now being filed in the U.S. (and particularly in California) on a regular basis.

The Canadian competition watchdog (the Competition Bureau) has thus far been less active than the FTC, particularly in the area of food. In addition, Canadian consumers tend to be less litigious than their American counterparts. However, this is not to say that Canadian food manufacturers are immune from reproach in connection with labels.

In Canada, mislabeled food can be subject to a Corrective Action Report and/or a recall. While food that has been inappropriately labeled as "natural" may not pose a risk to health and safety, it could be found to violate section 5 of the Food and Drugs Act (the prohibition against false and misleading advertising) and on this basis, could be ordered to be recalled. Keep in mind that the prohibition on false and misleading advertising extends to a food label and anything else that promotes the sale of that food, including advertisements, websites and social media.

In the end, industry has to balance the benefit of labeling food as "natural" with the potential risk of a finding that the claim is not warranted. As always, it is important to understand the regulatory landscape and to think twice before making claims just to meet current consumer trends. ■

"THEY'RE THE MOST SIGNIFICANT CHANGES REALLY EVER TO THE NUTRITION FACTS

TABLE. THEY WILL HAVE MAJOR, MAJOR IMPACTS ON THE INDUSTRY."

- FCPC spokesperson  
Adam Grachnik.

# Food irradiation adds cost but makes sense

RICHARD A. HOLLEY

Canada was an “early adopter” of food irradiation, but its status in Canada has remained unchanged for almost 50 years. This article explores reasons for maintenance of the *status quo* and offers a glimpse of how irradiation can be strategically used to improve the safety of food and the health of Canadians.

## CURRENT SITUATION

If government food safety initiatives and oversight are risk- and science-based in Canada, it is difficult to understand how the current impasse in appraising the application for extended use of food irradiation has occurred. On July 16, 2013, Health Canada granted “expedited status” for the evaluation of a petition from the Canadian Cattleman’s Association (CCA) to use low dose ionizing irradiation to eliminate *E. coli* O157:H7 from beef. There has been no meaningful progress to date, and no apparent political will to change that. While the Consumer’s Association of Canada supports adoption of the proposal and is impatient with the lack of progress, Health Canada is reluctant to move forward because of a history of activist opposition to the extended use of food irradiation to other foods<sup>1</sup> beyond its permitted use at 0.75 kilogray (kGy) for onions and potatoes, 1.5 kGy for grain and flour, and 10 kGy for spices and dried seasonings. During debates in 1986 and again in 2002 when an initiative for expanded use of food irradiation became a legislative proposal in Canada Gazette Part I, focused opposition led by activists halted its adoption.<sup>1</sup> While the CCA petition seems to have been temporarily swept under the rug and although it is hard to determine its status because of regulatory opacity, it appears that there will be little regulatory action until food irradiation is proven harmless to activists. It is uncertain how activists might differ physiologically from the normal consumer; however, it is clear that most are poorly qualified to design, conduct or evaluate scientific work examining the effects of this process on food (Note that issues associated with psychology and psychiatry are beyond the scope of this article).

The scientific basis for the toxicological safety and nutritional adequacy of food irradiated at doses of  $\leq 10$  kGy has been firmly established as a result of the most extensive body of international research ever accumulated for any food process.<sup>2</sup> Doses sufficient for sterilization of food with unaltered sensory characteristics ( $\leq 60$  kGy) were similarly considered acceptable<sup>3</sup> and have been used to prepare food for NASA (and Canadian) astronauts for  $> 40$  years. Both Health Canada<sup>4</sup> and the CFIA<sup>5</sup> have taken positions in support of the use of irradiation to improve the safety of food, but do not permit its use for that purpose in Canada. The safety of irradiated foods has been endorsed by the United States (U.S.) Centers for Disease Control (CDC), the U.S. Department of Agriculture, the U.S. Food and Drug Administration, and is approved for some food use in over 55 countries. Further, the CDC states that “food irradiation is a logical next step to reducing the burden of foodborne disease in the United States”.<sup>6</sup>

## STRATEGIC APPLICATIONS

The greatest potential value from the use of ionizing irradiation to enhance food safety is by treatment of uncooked foods of animal origin, particularly poultry, where “good food” is naturally, unavoidably and consistently contaminated with *Campylobacter*, *Salmonella* and toxigenic *E. coli* (beef), in spite of the best application of good hygienic practices and sanitation in abattoirs and packing plants. With the proliferation of “zero tolerance” rules in North America for pathogens in uncooked foods, the escalating waste and unnecessary cost of recalled animal and plant-based foods because they are not pathogen-free, the use of irradiation becomes an attractive solution. It is ironic that delayed adoption in Canada of expanded animal and plant-based food irradiation and adoption of “zero tolerance” rules have both been driven by “consumer” pressure, which has been fostered by perceived risk to the regulators themselves from the consequences of making either a science-based or politically expedient decision in response to the petition.

The next most strategic target for application of irradiation to improve the safety of food is animal feed. It is folly to ignore the contribution recycling of zoonotic pathogens by feed at both traditional small and large production facilities makes to contamination of human food. It must be remembered that it is within the gastrointestinal tract of healthy domestic animals where pathogens that most frequently cause foodborne illness are resident, multiply and are shed in large numbers from asymptomatic hosts. Irradiation of animal feed would be proactive and complementary to its treatment of food by preventing animal colonization by pathogens, reducing exposure of carcasses to pathogens at slaughter and reducing pathogen contamination of produce by inadequately composted, contaminated manure. Composting can effectively eliminate pathogens from manure but attaining lethal temperatures during the process is unpredictable and almost impossible in most places in Canada during winter. Dependable disinfection of produce cannot currently be achieved by any single treatment (even irradiation) and therefore prevention of contamination is the best, but seldom achieved, option for its safety when used uncooked as human food.

## LIMITATIONS AND OPPORTUNITIES

Food irradiation is not a panacea to eliminate foodborne illness but it can reduce its incidence by a substantial proportion and some estimates suggest by 25% if used for poultry, which is the single commodity responsible for most cases of foodborne illness in Canada<sup>7</sup> and deaths from foodborne illness in the U.S.<sup>8</sup> There are physico-chemical and sensory limits determining which foods can be successfully irradiated to improve safety. At doses effective for controlling bacterial pathogens many dairy products develop “off” flavours and odours caused by lipid oxidation, the whites of treated shell eggs become opaque and less viscous, shellfish (oysters, clams and mussels) die, yielding no advantage, and embryos in treated seeds become non-viable. Except for viruses which are resistant and prions, where the lethal target nuclear material is absent, pathogens can be controlled in most foods at doses  $\leq 5$  kGy, but if food is frozen or dried higher doses are required. In the U.S., spices and dried herbal seasonings may be irradiated at  $\leq 30$  kGy for sterilization.<sup>6</sup> Although contamination of grains and peanuts by mycotoxigenic fungi can be controlled by irradiation treatment at 5–6 kGy, doses of  $\geq 10$  kGy are needed to substantially reduce mycotoxin levels in grains.<sup>9</sup> Seeds for sprouting may be treated up to 8 kGy<sup>6</sup>, but in order to maintain the minimum commercial seed germination rate of 95%, lower doses are more practical. In fact, Sikin *et al.*<sup>10</sup> suggested that of all alternatives, including 20,000 ppm chlorine, to ensure the microbial safety of sprouted seeds (a recalcitrant cause of foodborne illness outbreaks), a 50 to 60°C treatment of seeds to be germinated followed by  $\leq 2.5$  kGy irradiation treatment of the sprouts (mung, radish, broccoli, alfalfa and soy) was the most effective and preserved functional and sensory properties. However, given

the small size of individual sprout production operations and their wide geographic distribution, it is unlikely this industry could afford access to irradiation facilities. Fresh produce is increasingly becoming a major contributor to foodborne illness outbreaks, and unlike in Canada where poultry is the leading cause of foodborne illness, leafy green vegetables are the food commodity responsible for causing most illness in the U.S.<sup>8</sup> Commercial treatments currently available for disinfecting produce are only marginally effective and irradiation is a viable alternative. Because fresh produce quality is reduced at treatments  $> 1$  kGy, a 220 ppm chlorine wash plus irradiation at 1 kGy<sup>11</sup> or a 1 kGy treatment in high oxygen atmospheres<sup>12</sup> were the most effective means to assure elimination of both surface and internal pathogen contamination of produce.

Although it is not strictly a food safety application, phytosanitary use of irradiation to control invasive, quarantine insect pests on imported fruits and vegetables has, since 1995, been used on a continuous basis in the U.S. and internationally for mangoes, papaya and a variety of similar products. In Canada, irradiation for insect disinfestation is only permitted for wheat flours and grain at  $\leq 1.5$  kGy, but for fruits and vegetables lower levels of 0.15 to 0.4 kGy are used commercially with success.<sup>13</sup> Because irradiation replaces the use of hot water immersion, heated air and methyl bromide fumigation, which are partly effective or undesirably toxic, the recent growth in phytosanitary use of irradiation can be expected to continue.

## DISADVANTAGES AND PERCEPTIONS

A technical problem associated with the more popular use of e-beam irradiation in the U.S. to avoid radioactive waste disposal problems and bad press accompanying use of radioactive isotopes ( $\gamma$ -ray sources) is its low penetrability. Even with double-sided or dual-pass exposures, the thickness of the e-beam target is limited to  $\leq 10$  cm and this makes it impossible to uniformly treat pallet-sized stacks of packaged food. Although there are also technical and cost issues that need to be overcome, machine generated x-rays are likely to become popular internationally for food irradiation because they have high penetrability, produce no hazardous waste, and the beam generated travels in more controllable parallel lines, rather than dispersed as with  $\gamma$ -rays.<sup>13</sup>

The claim by activists (Public Citizen) echoed by others (Sierra Club, Food and Water Watch, and the European Civil Society) that irradiation is a “cheap fix” for industry is not borne out by reality. With uncooked foods of animal and plant origin there is no suitable fix available other than irradiation to address “zero tolerance”. In terms of phytosanitary irradiation where alternatives are available for some types of produce to control quarantine insects, they are less expensive than irradiation. Costs of irradiation depend on the dose (type of source) required, proximity to an irradiation facility and throughput.

They can range from \$0.03 to \$1.97/kg (\$ U.S.) but can be moderated by efficiencies of scale.<sup>13</sup>

The formation of compounds (2-alkylcyclobutanones) believed to be uniquely radiolytic in origin and toxic was an objection raised by activists to food irradiation that received attention in earlier discussion. It now appears that they also occur in non-irradiated food<sup>14</sup> and may not be acceptable indicators to detect irradiated food, but more importantly this observation minimizes the argument that irradiation does strange things to food. As with any new idea and theory, time is on the side of robust science and eventually will be vindicated.

Objections to the irradiation of food invariably include a call for further whole food (WF) toxicity studies in animals to establish the safety of the process. To date over 30 lifetime WF studies have been conducted involving thousands of animals yielding no measureable effect on safety, yet results were often ambiguous because the studies did not have the sensitivity to identify specific effects of the irradiation treatment. At dietary levels of irradiated components sufficient to test for irradiation effects (chemical changes are so small), an unbalanced diet must be fed, which confounds the outcome.<sup>15</sup> With the sophistication and sensitivity of the analytical chemistry technology used today to test for radiolytic products as well as changes in nutrients, unambiguous results are possible and confirm both the nutritional adequacy and toxicological safety of irradiated food, and that further WF toxicity testing is unnecessary.

#### SUMMARY

While the experimental evidence is very clear that irradiation of food does not produce compositional changes that are of toxicological significance to humans, the controversy continues, fuelled by activists with agenda filled with suspicion of the food industry and regulatory agencies, while “good food” causes 11,000 Canadians to become ill each day<sup>16</sup>, (2013), and kill an unrecorded number as a result of bacterial pathogens controllable by irradiation. Although I am reluctant to go as far as Farkas and Mohácsi-Farkas<sup>2</sup> who suggested that those who provide misinformation about food irradiation are guilty of a form of “terrorism” because they contribute to delayed adoption of a technology that could prevent significant morbidity and mortality, I am disappointed that the evidence to date in Canada shows that the responsible regulatory authority appears reluctant to use available science as the basis for rule making. ■

#### References

- [1] Gauthier, E. (2010). Social representations of risk in the food irradiation debate in Canada, 1986-2002. *Sci. Communication*, 32: 295. Available at: <http://scx.sagepub.com/content/32/3/295> Accessed Sept. 19, 2014.
- [2] Farkas, J. & Mohácsi-Farkas, C. (2011). *Trends Food Sci. Technol.* 22:121.
- [3] WHO (1999). Joint FAO/IAEA/WHO Study Group. High-dose irradiation: wholesomeness of food irradiated with doses above 10 kGy. World Health Organization Technical Report Series 890, Geneva: Available at: <http://apps.who.int/iris/handle/10665/42203#sthash.x10bA6J5.dpuf> Accessed Sept. 23, 2014.
- [4] Health Canada (2013). Food irradiation: proposed regulatory changes-archived. Available at: [http://www.hc-sc.gc.ca/fn-an/secure/irradiation/rlo\\_pres-eng.php](http://www.hc-sc.gc.ca/fn-an/secure/irradiation/rlo_pres-eng.php) Accessed Sept 23, 2014.
- [5] CFIA (2014). Canadian Food Inspection Agency. Food irradiation. Available at: <http://www.inspection.gc.ca/food/information-for-consumers/fact-sheets/irradiation/eng/> Accessed Sept 23, 2014.
- [6] CDC (2014). Centers for Disease Control, USA. Irradiation of food. Available at: [http://www.cdc.gov/nczved/divisions/dfbmd/diseases/irradiation\\_food/](http://www.cdc.gov/nczved/divisions/dfbmd/diseases/irradiation_food/) Accessed Sept 23, 2014.
- [7] Ravel, A. et al. (2009). *J. Food Protect.* 72:1963.
- [8] Painter, J.A. et al. (2013). *Emerg. Infect. Dis.* 19:407.
- [9] Calado, T. et al. (2014). *Comp. Rev. Food Sci. Food Safety*, 13:1049.
- [10] Sikin, A. M. et al. (2013). *J. Food Protect.* 76:2099.
- [11] Puerta-Gomez, A.F. et al. (2013). *Food Control*, 31:410.
- [12] Olaimat, A.N. & Holley, R.A. (2012). *Food Microbiol.* 32: 1-19.
- [13] Hallman, G.J. (2011). *Comp. Rev. Food Sci. Food Safety*, 10:143.
- [14] Crews, C. et al. (2012). *J. Food Comp. Anal.* 26:1.
- [15] Bartholomaeus, A. et al. (2013). *Crit. Rev. Toxicol.* 43:1.
- [16] Thomas, M.K. et al. (2013). *Food. Path. Dis.* 10:639.

Department of Food Science,  
University of Manitoba, Winnipeg, Manitoba, R3T 2N2

(\*Corresponding author email: [rick\\_holley@umanitoba.ca](mailto:rick_holley@umanitoba.ca))

# Come to Saskatchewan... where the sky is blue and the land is gold.

The 14th International Rapeseed Congress (IRC 2015) is in Saskatoon, Saskatchewan July 5-9, 2015!

IRC is the most comprehensive global forum for discussing issues and advances in canola/rapeseed research, development, commercialization and utilization of canola/rapeseed and derivative products.

## Who should attend IRC 2015?

scientists, students, policy analysts, industry managers, government, producer groups, trade associations

#### TOPICS:

- ◆ discovery sciences
- ◆ plant breeding strategies
- ◆ crop protection
- ◆ climatic stress
- ◆ seed quality and utilization
- ◆ nutritional value of oil and meal
- ◆ agronomy and crop management
- ◆ economic and policy issues

14th International  
Rapeseed  
Congress

SASKATOON 2015

July 5-9, 2015

Innovation for Tomorrow

Register today to take advantage of the early bird rate!

**Researchers: Abstract deadline is Feb. 1, 2015!**

[www.agwest.sk.ca/events/26](http://www.agwest.sk.ca/events/26)



 @agwestbio  
#IRC2015





# The roles of physics in foods

MODELLING, COMPUTER SIMULATION AND THINGS YOU PROBABLY NEVER KNEW ABOUT

DAVID PINK<sup>1,2</sup> | MICHAEL NICKERSON<sup>3</sup>

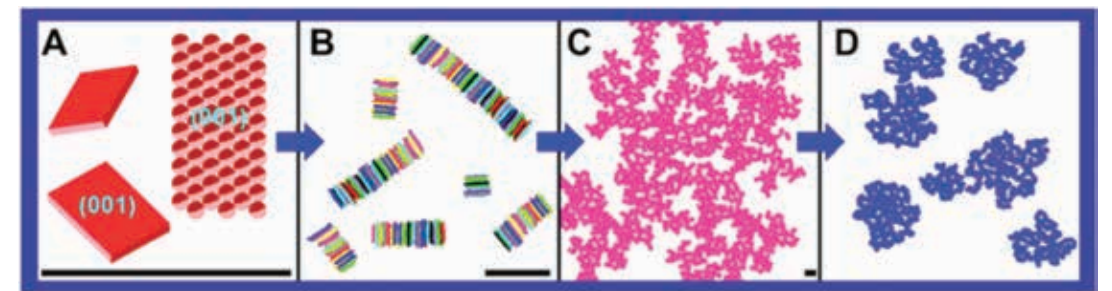
Before Alberta Einstein made it big, he served as a clerk in a Swiss Patent Office in Bern Switzerland around 1903, during which time he logged in the patent for Toblerone bar for its characteristic triangular prism shape resembling that of the Swiss Alps. Since then, the link between physics and foods has grown. Physicists have been helping the food industry around the world, although less so in Canada, with product re-formulation, process optimization and ensuring food structure and quality – all through the use of mathematical equations and, now, computer simulation. In the latter, one can inspect visually the results of modelling a food and so actually see structures that one might not have guessed at. In order for Canada's food industry to remain competitive in a global marketplace, we need to start emulating what's being done in Europe, especially in The Netherlands and Germany. We need to begin making use of the wealth of physics expertise and computer power available in Canada to model, and thereby point the way to optimizing and enhancing their products and processes for quality, functionality and economic value. This article highlights a few instances of how collaboration between theoretical physicists and food scientists played out.

## THE EDIBLE OIL IDENTITY

Imagine that you're a manufacturer who produces shortenings, and you have been asked to reformulate your product, to replace some of the solids with "some other ingredient", for reasons of cost, ingredient availability, consumer demand or simply to make it healthier. As a product developer, you must ensure that your consumers are totally unaware of any changes in taste or mouth-feel – all they must know is that it is less expensive or healthier. However the problem with edible oils is that they are extremely complicated and generally, by trying to guess how to modify your edible oil for a given process, you won't succeed. The reason is that you are conducting, at best, an "intelligent" search in a multi-dimensional space of the oil components and, mathematics says that your search will frequently not succeed.

A better way to try to modify your product is to discover how it is constructed – what structures exist inside your oil so that you know, up front, what you have to maintain so that a consumer cannot tell that you have made changes.

Can you discover what you need to know by experiments alone? Unfortunately, not really. In order to understand what the experiments are telling you, you need a (mathematical) model. If you think about it, everything that you experience, you interpret in terms of some sort of "mental model". And the best mathematical modellers are theoretical physicists and chemists: experts who can model BIG complicated systems, for LONG times. As proof of concept, we have been modelling edible oils over the past two years.<sup>1</sup> Initially, we began our work with what we knew about edible oils on a nanometer scale (one billionth of a meter). In 2009, Nuria Acevedo and Alejandro Marangoni<sup>2</sup> showed that the smallest stable solid structures in edible oils at room temperature were (flat) Crystalline NanoPlatelets (CNPs) with sides of about 100-1000 nanometers in length and about 10-100 nanometers thick. We figured out how to construct a simple but adequate mathematical model of them, figured out how to calculate the attractive van der Waals interactions between two such CNPs, and carried out computer simulations of the model to see what would happen as the model CNPs interacted with each other, as they rotated and moved around in the liquid oil. This simulates a simple food processing operation in which shear does not play a dominating role, though mixing and simple dynamics are involved. Over the last 2 years, we predicted that CNPs would aggregate into 1-dimensional multilayer sandwich-like structures, which, in turn, would aggregate into 10-100 micron-scale fractal (i.e., self-similar) structures. This is summarized in Figure 1. Apart from the structures shown, we predicted that, if the system is cooled rapidly and the experiment carried out, then only A and B would be observed, while, if the cooling is slow, then A–D will be observed.



**Figure 1:** Two CNPs and their representation as a rigid flat close-packed structure made from spheres. **B:** CNPs aggregate into "TAGwoods" – multilayers of CNPs. **C:** TAGwoods aggregate into larger structures via diffusion (and reaction) limited cluster-cluster aggregation (DLCA/RLCA). **D:** DLCA/RLCA aggregates fill the space uniformly on the average. The black bar shows the same length scale of ~100–1000 nm. With permission from Pink, et al. *J. Applied Phys.* (2013) 114, 234901, Copyright 2013, AIP Publishing LLC.

We performed experiments using ultra small angle X-ray scattering at the Argonne National Laboratory (Lemont, IL, USA), and our predictions were entirely confirmed.<sup>3</sup> With this success, we extended our models to include CNPs in multi-component liquid oils.<sup>4</sup> We predicted that these CNPs could become coated with minority-components of the oil and so bind together in different ways so as to create environments that would enable the large resulting fractal aggregates to bind liquid oil within their structure. In this way, we like to think that we have made a contribution to understanding the basis for an edible oil to possess the necessary stable oil-binding capacity so that it functions as it should. These results are all in the public domain. However, our colleagues at the University of Guelph with direct connections to industries have taken note of them and, together with other information that we have provided, are exploring, in collaboration with us, targeted modifications of edible oils.

## THE HONEY CONNECTION

In 2014, David Pink carried out a 6-month Engage grant project with Cornect Family Farms, a small rural Nova Scotia company engaged in producing flavoured creamed honeys. They had formulation concerns and wanted precise affordable answers concerning solubilization of natural additives into their products. This was clearly an "Physics" problem instead of a "Chemical" problem and it was undertaken in collaboration with Dr. E. Papp-Szabo in Guelph. The project required an understanding of the phase separation of natural additives, and how the physics of solvation was applicable to a complex system like honey, and was a huge success. Another joint project with the same company has just been funded thus expanding the application of physics into a honey-related field.

## FOUR HORSEMEN OF THE NEW APOCALYPSE: CHICKEN BREASTS, OIL MIGRATION, CHEESE AND DOUGH

The link between physicists and the food industry, especially in Western Europe, has been strong for some decades. This is not an exhaustive review and we can only touch upon some recent examples. One should read the articles by Athene Donald.<sup>5,6</sup>

Ruud van der Sman has employed mathematical models to understand heat and mass transport in cooking chicken breast.<sup>7</sup> These are based upon differential equations which, in some cases, have to be solved using numerical integration. This work is important for one must balance heat and mass flow in a soft complex structure against minimal output of time and energy in order to minimize production costs while ensuring that the product is safe to eat and resembles what a consumer thinks a chicken breast should be. Others have used atomic scale molecular dynamics to study protein restructuring and triacylglycerol oil migration. One area that has been modelled to some extent is casein micelle aggregation and degradation. This can take place via (a) rennet-induced enzymatic activity, (b) pH change via acidification or (c) application of heat treatments. These processes underlie those used in the manufacture of cheese or cheese-based products (cream cheese, processed cheese, etc.). Are not these processes already well-known? Why involve physicists? Because, although the chemistry is understood, details of the physical structures that emerge are not. Industries are realizing that the knowledge of cheese product structures on the scale of ~1–100 microns is likely to be very important in (a) designing new products and (b) making manufacturing processes more efficient without sacrificing quality. What happens to casein micelles and their components when they are acid- or heat-treated? What structures are formed on nano- and micro-scales? And, it is not only such cheese products that pose a challenge to understanding their nanoscale structure. Dough, a product that has been around for thousands of years, carries its own mysteries. Nano- and micro-scale structural details and dynamics, which are important for some processes in bread production, are hidden under a

cloud of unknowing. These are a few examples of fascinating challenges to any thinking physicist who works in the field of “soft condensed matter”.

#### LA NOUVELLE VAGUEE AND THE DOORWAY TO THE FUTURE

Why is it that we can actually create mathematical models of food structures? Why is it that we are able to understand old phenomena and predict new phenomena, thereby pointing the way towards how to manipulate the particular food? The reason is that we have realized that food is a class of materials known as “soft condensed matter”. Theoretical physicists and chemists have been dealing with such soft materials for many decades and have developed techniques to model them.<sup>8,9,10</sup> The Royal Society of Chemistry organized in 2012 a conference, “Soft Matter approaches to Structured Foods” at Wageningen in The Netherlands.<sup>11</sup> And in 2015 a Gordon Conference will introduce a new scientific forum for researchers of Nanotechnology for Agriculture and Food Systems.<sup>12</sup> These activities show there is a tide that is now flowing and those who do not make use of it might be left behind. Turning towards the future, one growth area is involved with calculating the effects of shear upon food structures. Shearing a system is like stirring it: you want parts of a fluid to move more rapidly than other parts. If one thinks about it one realizes that shearing occurs more often than not. But, to model shear properly one must satisfy certain conditions. If one wants to cause a fluid to move in a model oil or a water-based system, then one must ensure that the procedure used is in accord with the Navier-Stokes equations, the fundamental equations describing fluid flow. But, generally, food systems are so complicated that one must use computer simulation techniques to predict new phenomena. One must therefore find a way of applying the Navier-Stokes equations to complex computer simulations<sup>10</sup>. The approach enables us to emulate shear that occurs within fluid flow within a processing plant or during mastication.

I haven't mentioned “kinetics”: how a system changes as time goes by. This is very important to many processes and one must take care in modelling such dynamical aspects correctly. Mechanisms of relaxation, the appearance and importance of metastable states, the onset of phase transitions and changes are all processes that are important in understanding the complex materials that make up “food”.

#### RIDING THE TORNADO OF CHANGE

I have twice mentioned “prediction” of new phenomena. Let's face it: in science Prediction Rules. If your model only “explains” phenomena without predicting the outcome of new experiments, then it is not a useful model. With the advent of high-performance computers and GPUs, mathematical modelling has come of age. Aircraft, cars and ships are designed

that way, so why not food? The Airbus 380 was “flown” on a computer before it ever left the ground – and it flew exactly as its computer model predicted. Drones, autodrives, Mars landers, you name it... are all designed or manipulated via computer software.

The Times They Are a-Changin'.<sup>13</sup> With an ever changing food industry in Canada, a company's competitiveness should be at the forefront of any strategic vision. Physicists can play key roles in facilitating greater process optimization, ingredient reformulation and product quality, such that the Canadian Food Industry remains competitive in an increasingly-competitive global food environment. ■

#### References

- [1] Pink, D.A. et al. (2013) J. Applied Phys. 114: 234901
- [2] Acevedo, N.C. & Marangoni, A.G. (2010) Crystal Growth Des. 10: 3327.
- [3] Peyronel, F. et al. (2013) J. Applied Phys. 114: 234902.
- [4] Quinn, B. et al. (2014) J. Phys. Condens. Matter. In press.
- [5] Donald, A.M. (1994) Rep. Prog. Phys., 57: 1081.
- [6] Donald, A. (2004) Nature Materials, 3: 579.
- [7] van der Sman, R.G.M. (2013) Meat Science, 95: 940.
- [8] Mezzenga, R. et al. (2005) Nature Materials, 4: 729.
- [9] Pink, D.A. et al. (2013) Physics in Canada 69: 93.
- [10] Pink, D.A. et al. (2014) Computer Simulation Techniques for Modelling Statics and Dynamics of Nanoscale Structures, in Edible Nanostructures: A Bottom-up Approach (eds. A.Marangoni, D.Pink) Roy. Soc. Chem, Oxford, Chapter 9.
- [11] Royal Society of Chemistry, Faraday Discussions 158, Soft Matter Approaches to Structured Foods, Wageningen, The Netherlands, 2-4 July 2012.
- [12] Gordon Research Conference. Nanoscale Science & Engineering for Agriculture & Food Systems. June 7-12, 2015
- [13] Dylan, B. (1964) Columbia Records, 13 January.

<sup>1</sup>Physics Department, St. Francis Xavier University, Antigonish, NS

<sup>2</sup>Food Science Department, University of Guelph, Guelph, ON

<sup>3</sup>Department of Food and Bioproduct Sciences, University of Saskatchewan, Saskatoon, SK

(\*Corresponding author email: scorpiocarla@gmail.com)

# Supercritical carbon dioxide technology

FOR FOOD AND NATURAL HEALTH PRODUCTS

FERAL TEMELLI\* | MARLENY D.A. SALDAÑA

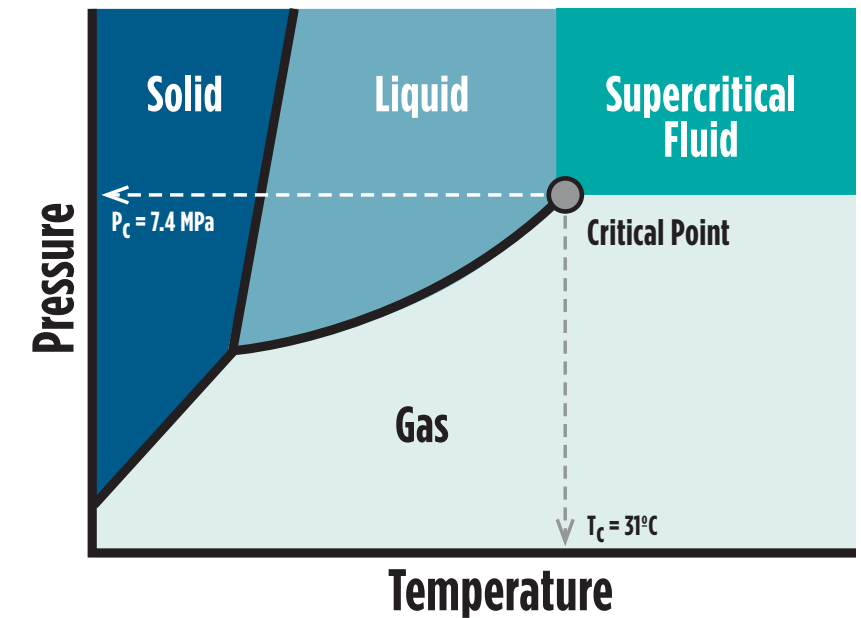
## INTRODUCTION

Based on the significant developments in research and know-how in the area of supercritical fluid technology over the past three decades, supercritical carbon dioxide (SC-CO<sub>2</sub>) extraction and fractionation of natural ingredients have become main stream operations in the rapidly growing functional food and natural health products industry, fueled by the consumer demand for “natural” ingredients/products. Today, companies are advertising the use of SC-CO<sub>2</sub> on their web sites and product labels as a marketing advantage over the use of organic solvents and promoting the benefits of SC-CO<sub>2</sub> to produce a “natural” extract.

A fluid is under supercritical conditions when temperature and pressure are above its critical point. This dense fluid has interesting properties in between those of a gas and a liquid. Its density is similar to that of a liquid, while its viscosity and diffusivity are similar to those of a gas. The solvent power can be tuned by adjusting temperature and pressure. The supercritical fluid of choice for food applications has been CO<sub>2</sub> due to its moderate critical point of 31°C and 7.4 MPa (Fig. 1). CO<sub>2</sub> is considered a “green solvent” and it is cheap, abundant and non-flammable. Furthermore, CO<sub>2</sub> can be easily separated from the final product upon depressurization, eliminating concerns over solvent residues and avoiding heat treatments employed for removal of organic solvents. Processing in CO<sub>2</sub> environment, in the absence of oxygen also minimizes degradation of sensitive bioactives.

Numerous studies have reported the extraction and fractionation of plant materials using SC-CO<sub>2</sub> technology. In fact, searching for ‘supercritical extraction’ on the Web of Science (on Oct. 29, 2014) resulted in 35,450 articles, majority

Figure 1: Phase diagram of CO<sub>2</sub> (T<sub>c</sub>: critical temperature, P<sub>c</sub>: critical pressure).



of which are related to natural products, demonstrating the level of activity in this field. This article provides a brief overview of the basic principles of SC-CO<sub>2</sub> extraction, its status in the world and in Canada and a future outlook for further development.

## FUNDAMENTALS OF SC-CO<sub>2</sub> EXTRACTION

Both mass transfer kinetics and equilibrium solubility influence the extraction rate where a solid material containing a solute of interest is contacted with SC-CO<sub>2</sub> over a period of time. A good understanding of the solubility behavior of the target components in SC-CO<sub>2</sub> is essential since solubility is the driving force for extraction. Solvent power of SC-CO<sub>2</sub> is dictated by its density, which is a strong function of temperature and pressure.

Density increases with pressure, leading to a dramatic increase in solubility. On the other hand, increasing the temperature causes a decrease in SC-CO<sub>2</sub> density while increasing the vapor pressure of the solute. The net effect of these two opposing factors dictates the change in solubility. At low pressures close to the critical point, the decrease in SC-CO<sub>2</sub> density is more dramatic so that solubility decreases with temperature whereas at higher pressures the vapor pressure effect takes over, leading to solubility increase.

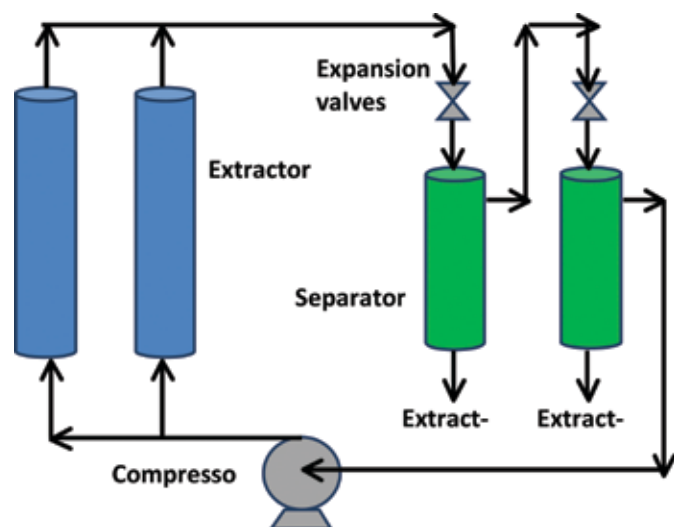
Solute properties, especially polarity, molecular weight and vapor pressure also influence solubility in SC-CO<sub>2</sub>. Due to the non-polar nature of CO<sub>2</sub>, it is more selective towards non-polar components, like neutral lipids. For polar solutes, a polar co-solvent such as ethanol can be added to adjust the polarity of the supercritical solvent. However, the additional step of ethanol removal from the extract should not be overlooked. Solubility decreases with molecular weight of a solute. Therefore, non-polar solutes of low molecular weight and high vapor pressure are preferentially solubilized in SC-CO<sub>2</sub> at relatively low density conditions and higher density conditions are needed for larger, slightly polar and less volatile solutes. High selectivity can be achieved by simply adjusting the temperature and pressure, which is a major advantage of the SC-CO<sub>2</sub> extraction technology, thus minimizing additional refining requirements in most cases.

#### EXTRACTION EQUIPMENT AND OPERATION

Regardless of the scale of operation, a SC-CO<sub>2</sub> extraction unit consists of four main components: pump, extraction vessel, depressurization valve and separator (Fig. 2). Other components are temperature and pressure controllers, heat exchangers, piping, valves and rupture disks for overpressure.

The operation starts by loading the plant material into a basket, which is then placed into the extraction vessel. It is advantageous to decrease the particle size to enhance contact surface area and to decrease the moisture content of plant material to optimal level depending on the target solute. The system is then filled with CO<sub>2</sub> and pressurized using the pump to the desired pressure while the temperature is adjusted with the use of heaters around the vessel. SC-CO<sub>2</sub> extracts the components solubilized under the set conditions and carries them out of the vessel. Upon depressurization, SC-CO<sub>2</sub> becomes a gas, separates from the extract and the extract is collected in the separation vessel. Depressurization is achieved through a micrometering valve, which needs to be heated to prevent freezing due to the Joule-Thomson effect upon depressurization. Subsequently, the expanded CO<sub>2</sub> passes through a flow meter and a gas meter to determine the total volume of CO<sub>2</sub> used. In general, lab-scale units are not

Figure 2: Typical SC-CO<sub>2</sub> extraction system.



equipped to recycle the CO<sub>2</sub> and the exhaust CO<sub>2</sub> is vented while industrial plants recycle CO<sub>2</sub>.

The majority of the industrial plants are equipped with several extraction vessels and operate in a semi-continuous mode, where one vessel is used for loading and unloading the solid material. These vessels have quick-opening closures that are often automated to minimize downtime. It is also common for these plants to have more than one separation vessel where the pressure is dropped in a sequential manner to collect different fractions extracted (Fig. 2).

Although the majority of industrial plants operate at pressures of 30–50 MPa, there is growing interest towards the use of much higher pressures of up to 100 MPa for the extraction of natural materials.<sup>1</sup> Under such conditions, the solubility of solutes in SC-CO<sub>2</sub> increases substantially. Thus, higher yields can be achieved in a shorter period of time using lower solvent-to-feed ratios. However, the cost of such units would be higher.

#### INDUSTRIAL APPLICATIONS

Earliest industrial scale SC-CO<sub>2</sub> extraction plants going back to late 1970s were for coffee/tea decaffeination and hops extraction built in Germany. Since then supercritical fluid technology has experienced major growth at the industrial scale. King<sup>1</sup> estimated that there are over 150 plants operating around the world. Majority of these plants are targeting the extraction of various components from plants, algae and other sources, for applications in food, natural health products, personal care products and cosmetics. Table 1 provides examples of extracts obtained by SC-CO<sub>2</sub>. A major focus is high value, low

volume specialty oils which are rich in bioactive components, including polyunsaturated fatty acids, carotenoids, tocopherols, and phytosterols. As well, spice extracts including essential oils and oleoresin fractions, herbal extracts, flavors and fragrances, pigments and antioxidants make up a substantial portion of the supercritical extracts available on the market.

STATUS OF SC-CO<sub>2</sub> TECHNOLOGY IN CANADA  
Efforts are underway at laboratory, pilot plant and commercial scale focusing on SC-CO<sub>2</sub> processing of natural materials in Canada as summarized in Table 2. Research activities at universities lead the way in lab-scale (<1 L vessels) efforts. The laboratories and the expertise of the authors at the University of Alberta are at the forefront, built over the past 26 years. Their research programs focus on value-added processing of Canadian agricultural resources with an emphasis on lipids<sup>2</sup> and nutraceuticals.<sup>3,4</sup> Supercritical research activities are based on various unit operations, ranging from extraction<sup>3,4</sup> from different sources to column fractionation<sup>5</sup>, conversions to high value components using enzymatic and non-enzymatic reaction systems<sup>6–8</sup>, membrane separation<sup>9</sup> and particle formation<sup>10</sup>, with the goal of integrating these unit operations to develop novel supercritical processes. Their lab is equipped with systems corresponding to each unit operation. Majority of the systems are custom built utilizing high pressure parts and vessels and/or modified in unique ways to meet various project goals. Extraction capabilities include both SC-CO<sub>2</sub><sup>3</sup> and subcritical water<sup>11–13</sup> extraction. Such process development is based on a solid understanding of fundamentals, requiring capabilities to measure fundamental data under high pressure conditions. Using vessels equipped with sapphire windows, it has been possible to establish phase behavior of various mixtures and perform solubility measurements. Various physical properties such as density, volumetric expansion, viscosity, interfacial tension, melting point and diffusion coefficients were determined. For example, solubility behavior of lipids<sup>14,15</sup> and nutraceuticals<sup>16</sup> as well as physical properties<sup>17,18</sup> of CO<sub>2</sub>-expanded lipids have been evaluated, demonstrating the dramatic decrease in viscosity and interfacial tension of lipids with increasing CO<sub>2</sub> pressure. Such fundamental data are challenging to measure under high pressure, but essential for equipment and process design and optimization. More recently, research activity is expanding at other university labs but mostly focusing only on the extraction

Table 1

Company	Location	Products	Reference (websites accessed on Nov. 1, 2014)
Aromtech	Finland	Extracts of blackcurrant, lingonberry, seabuckthorn	www.aromtech.com
Firmenich	France	Flavors and fragrances	www.firmenich.com
Flavex	Germany	Flavors, spice extracts, plant oils	www.flavex.com
Evonik	Germany	Tea/coffee decaffeination, hop and other plant extracts	www.evonik.com
NatCO2	Germany	Plant extracts and oils	www.nateco2.de
Flaveko Trade spol. s.r.o.	Czech Republic	Botanical extracts	www.supercriticalextraction.eu
Feyecon	The Netherlands	Algae and plant extracts, flavors, fragrances, colorants	www.feyecon.com
Proderna Biotech	India-The Netherlands	Essentials oils and oleoresins of various plants	www.proderna.com
Synthite	India	Spice extracts	www.synthite.com
Honsear Sunshine Biotech	China	Plant extracts and essential oils	www.honsearbio.com
Nutrizeal	New Zealand	Extracts of marine, algae and plant sources	www.nutrizeal.com
Fuji Flavor	Japan	Natural food flavors	www.fjf.co.jp
Valensa International	USA	Extracts of perilla, chia, saw palmetto, carotenoids from algae, krill oil	www.valensa.com
Barth-Hass Group	Germany, USA, Australia, China	Hop extracts	www.barthhassgroup.com
MOR Supercritical LLC	USA	Corn germ	www.reyntek.com/MOR/SC

<sup>1</sup>Source: Personal communication, Dr. Jerry W. King, Professor Emeritus, University of Arkansas

of different plant materials (Table 2).

As in any new technology development, once optimization of processing parameters is performed at lab scale, it needs to be fine-tuned and verified at pilot scale before scaling up to industrial level. Several pilot scale extraction units (1–10 L vessels) are available at different organizations across Canada (Table 2), where feasibility studies can be performed.

At commercial scale, Norac Technologies in Edmonton, AB has been in the forefront since the 1980s. They established an

extraction plant with 4X250 L vessels, which was later acquired by Newly Weds Foods. Their main product is a rosemary extract, NatureGuard™, with potent antioxidant activity and used in various fat-containing food formulations to control lipid oxidation and extend shelf life. Ceapro Inc., Edmonton, AB, recently signed a licensing agreement with the University of Alberta to scale up and commercialize a supercritical drying technology<sup>19</sup> for high molecular weight biopolymers, specifically targeting oat beta-glucan. They are in the process of scaling up the technology from the laboratory to commercial scale. In addition, Mount Echo Naturals, QC and Blue Ocean Nutrasciences, ON are promoting their use of SC-CO<sub>2</sub> technology for their seabuckthorn and astaxanthin/omega-3 products, respectively; however, information on their production capabilities is not readily available.

#### FUTURE OUTLOOK

The activities in Canada focusing on the use of SC-CO<sub>2</sub> technology for the processing of “natural” materials is on the rise, reflecting some of the major developments around the world. Cost of the process is still the main question for many people with the impression that supercritical technology is expensive. Indeed, SC-CO<sub>2</sub> technology requires high pressure equipment with high initial capital investment. However, it should not be overlooked that the overall process is simpler compared to conventional solvent extraction processes, avoiding the need for solvent evaporators and meal desolventizers. On the other hand, the operating cost is lower, again eliminating the need for organic solvents. The commercial scale operations around the world have been targeting low-volume, high-value products, such as specialty oils rich in polyunsaturated fatty acids, carotenoids, tocopherols, etc. It has been demonstrated that for high volume commodity oils, it is a matter of scale and that SC-CO<sub>2</sub> extraction to replace the conventional solvent hexane would be competitive at large enough scales.<sup>20</sup> The main challenge in large-scale handling of feed materials like oilseeds is the lack of a truly continuous high pressure extractor, despite the fact that many equipment manufacturers have been working on it.

**Table 2** Capabilities for supercritical fluid processing in Canada for food and natural health products

Institution, Location	System	Capacity
<b>Lab scale (&lt;1 L)</b>		
Agri-Food Discovery Place, University of Alberta (Agricultural, Food and Nutritional Science), Edmonton, AB	Phase equilibria Extraction Column fractionation Packed-bed enzymatic reactor Stirred reactor Membrane separation Particle formation  SC-CO <sub>2</sub> drying Supercritical chromatography Subcritical water extraction Supercritical water reaction	10 mL 300 mL 3 m x 2.5 cm diameter column 19.30 cm x 6.22 mm ID 200 mL Dead-end and cross-flow SAS, aerogels, liposomes, solid-lipid nanoparticles 200 mL 20, 50, 250 mL 20, 100, 200 mL
University of Saskatchewan (Chemical Engineering), Saskatoon, SK	Extraction	400 mL
Richardson Center for Functional Foods and Nutraceuticals, Winnipeg, MB	Supercritical chromatography	
University of Manitoba (Biosystems Engineering), Winnipeg, MB	Extraction	300 mL
Western University (Chemical and Biochemical Engineering), London, ON	Extraction Particle formation (RESS, GAS) Phase equilibria Reactors	10 mL 100 mL 25 mL 600 mL
Loyalist College, Belleville, ON	Extraction	100 mL
AAFC, Guelph, ON	Extraction	10 mL
AAFC, Summerland, BC	Extraction	500 mL
<b>Pilot scale (1-10 L)</b>		
Ceapro Inc., Edmonton, AB	SC-CO <sub>2</sub> drying	2 L vessel
Centre of Chemical Process Studies of Quebec (CEPROCQ), Montreal, QC	Extraction Micronization	1.5 kg feed material
Richardson Center for Functional Foods and Nutraceuticals, Winnipeg, MB	Extraction	1 L and 5 L
Food Development Centre, Portage la Prairie, MB	Extraction	2 x 5 L + 3 separators
Food Technology Centre, Charlottetown, PEI	Extraction	2 L and 12 L
POS Bio-Sciences, Saskatoon, SK	Extraction	1-5 L
Loyalist College, Belleville, ON	Extraction	4 L + 3 separators
<b>Commercial scale</b>		
Newlyweds Foods, Edmonton, AB	Rosemary extract	4 x 250 L

SAS, supercritical anti-solvent; GAS, gas anti-solvent; RESS, rapid expansion of supercritical solutions

Recent developments in particle formation using SC-CO<sub>2</sub> technology are opening new opportunities for design of delivery systems for bioactives. Particles of nano/micro scale can be formed with characteristics that cannot be matched by conventional technologies. Different approaches like supercritical anti-solvent (SAS) particle formation, aerogels, liposomes, solid lipid nanoparticles are under investigation in our labs for novel ingredient development. Such approaches would allow the integration of extraction and particle formation units to be able to extract a bioactive from a plant source and encapsulate in a coating or impregnate on a carrier material in two steps without exposing the bioactive to oxygen.

Integration of various supercritical unit operations would also contribute to building biorefineries<sup>21</sup>, which would also include some conventional operations. It is also possible to integrate SC-CO<sub>2</sub> operations with subcritical water technology<sup>22</sup> as another ‘green’ solvent. This would allow maximum utilization of our agricultural resources targeting both food and non-food applications simultaneously. Such approaches are essential for a sustainable bio-economy and critical fluid technologies can play a major role in this development.

Considering all the latest developments, the future of supercritical technology is bright, capitalizing on its unique advantages that cannot be matched by conventional techniques, and thus meeting important consumer demand for “natural” ingredients. Based on research, anchored on solid understanding of the fundamentals, we can look forward to seeing more ingredients processed with SC-CO<sub>2</sub> in various food and natural health products. ■

#### References

- [1] King JW. *Ann Rev Food Sci Technol* 5 (2014) 215-218.
- [2] Temelli F. *J Supercrit Fluids* 47 (2009) 583-590.
- [3] Temelli F, Saldaña MDA, Moquin PHL, Sun M. In *Supercritical fluid extraction of nutraceuticals and bioactive compounds*, Martinez, JL. (Ed), CRC Press, Taylor and Francis Group: NY, USA, 2008, pp 51-101.
- [4] Saldaña MDA, Gamarra FMC, Siloto RMP. In *Emerging technologies used for the extraction of phytochemicals from fruits, vegetables, and other natural sources*; de la Rosa LA, Alvarez-Parrilla E, Gonzalez-Aguilar GA. (Eds), Blackwell Publishing: Iowa, USA, 2010, pp 235-270.
- [5] Guclu-Ustundag O, Temelli F. *J Am Oil Chem Soc* 84 (2007) 953-961.
- [6] Moquin PHL, Temelli F, Sovová H, Saldaña MDA. *J Supercrit Fluids* 37 (2006) 417-424.
- [7] Ciftci D, Saldaña MDA. *J Supercrit Fluids* 72 (2012) 255-262.
- [8] Prado GHC, Khan M, Saldaña MDA, Temelli F. *J Supercrit Fluids* 66 (2012) 198-206.
- [9] Akin O, Temelli F. *J Supercrit Fluids* 66 (2012) 150-156.
- [10] Comin L, Temelli F, Saldaña MDA. *J Food Eng* 111 (2012) 625-631.
- [11] Singh PP, Saldaña MDA. *Food Res Int* 44 (2011) 2452-2458.
- [12] Sarkar S, Alvarez VH, Saldaña MDA. *J Supercrit Fluids* 93 (2014) 27-37.
- [13] Alvarez VH, Cahyadi J, Xu D, Saldaña M.D.A. *J Supercrit Fluids* 90 (2014) 8-17.
- [14] Guclu-Ustundag O, Temelli F. *J Supercrit Fluids* 31 (2004) 235-253.
- [15] Prado I, Giufrida WM, Alvarez VH, Cabral VF, Quispe-Condori S, Saldaña MDA, Cardozo-Filho L. *J Am Oil Chem Soc* 88 (2011) 1263-1269.
- [16] Saldaña MDA, Temelli F, Guigard SE, Tomberli B, Gray CG. *J Food Eng* 99 (2010) 1-8.
- [17] Jenab E, Temelli F. *J Supercrit Fluids* 58 (2011) 7-14.
- [18] Seifried B, Temelli F. *J Supercrit Fluids* 52 (2010) 203-214.
- [19] Temelli F, Seifried B. PCT application PCT/CA2011/000360, filed Apr. 1, 2011.
- [20] Perrut M. *Ind Eng Chem Res* 39 (2000) 4531-4535.
- [21] Temelli F, Ciftci ON. *J Supercrit Fluids* (2014) DOI: 10.1016/j.supflu.2014.09.028.
- [22] Saldaña MDA, Valdivieso-Ramirez CS. *J Supercrit Fluids* (2014) DOI: 10.1016/j.supflu.2014.09.037.

Department of Agricultural, Food and Nutritional Science  
University of Alberta  
Edmonton, Alberta, Canada T6G 2P5

(\*Corresponding author email: feral.temelli@ualberta.ca)



# Nonbrowning Arctic® Apples

Creating A Consumption Trigger With Biotechnology's Help

Apple consumption has been declining for years, and barely any apples are sold in the foodservice industry despite consumers spending half their food dollars there. The reason? Browning. The solution? Nonbrowning Arctic® apples!

Okanagan Specialty Fruits, a small, grower-led technology company based in British Columbia has developed a way to make any existing apple variety nonbrowning through the use of biotechnology. We simply silenced the genes that produce polyphenol oxidase, the enzyme that drives browning in apples, so Arctic apples won't brown when bitten, sliced or bruised.

These biotech-enhanced apples have been rigorously tested for over a decade and have no new proteins. They're also just as nutritious as their conventional counterparts, and after cutting, better retain their healthful nutrients like Vitamin C and antioxidants that are typically "burned up" in the browning reaction.

There are low-browning varieties in existence, but only Arctic apples are truly nonbrowning, offering many unique advantages. Apples are one of the most wasted foods on the planet, and Arctic apples can significantly reduce waste associated with superficial browning which occurs throughout the supply chain. Additionally, consumers are

demanding more convenience than ever, and the nonbrowning trait means consumers can serve sliced apples in salads, fruit plates, in their kids' lunches and more without ever worrying about them becoming brown and unappealing!

Commercial processors stand to benefit in a big way too, as Arctic apples don't require expensive anti-browning treatments that can be up to 40% of the cost and sometimes create an unpleasant "off-taste". Nonbrowning apples are perfectly suited to freshcut products, which are gaining popularity due to their "snackability". Just as baby carrots doubled carrot consumption, Arctic apples can offer significant benefits to consumers while improving producers' bottom lines!



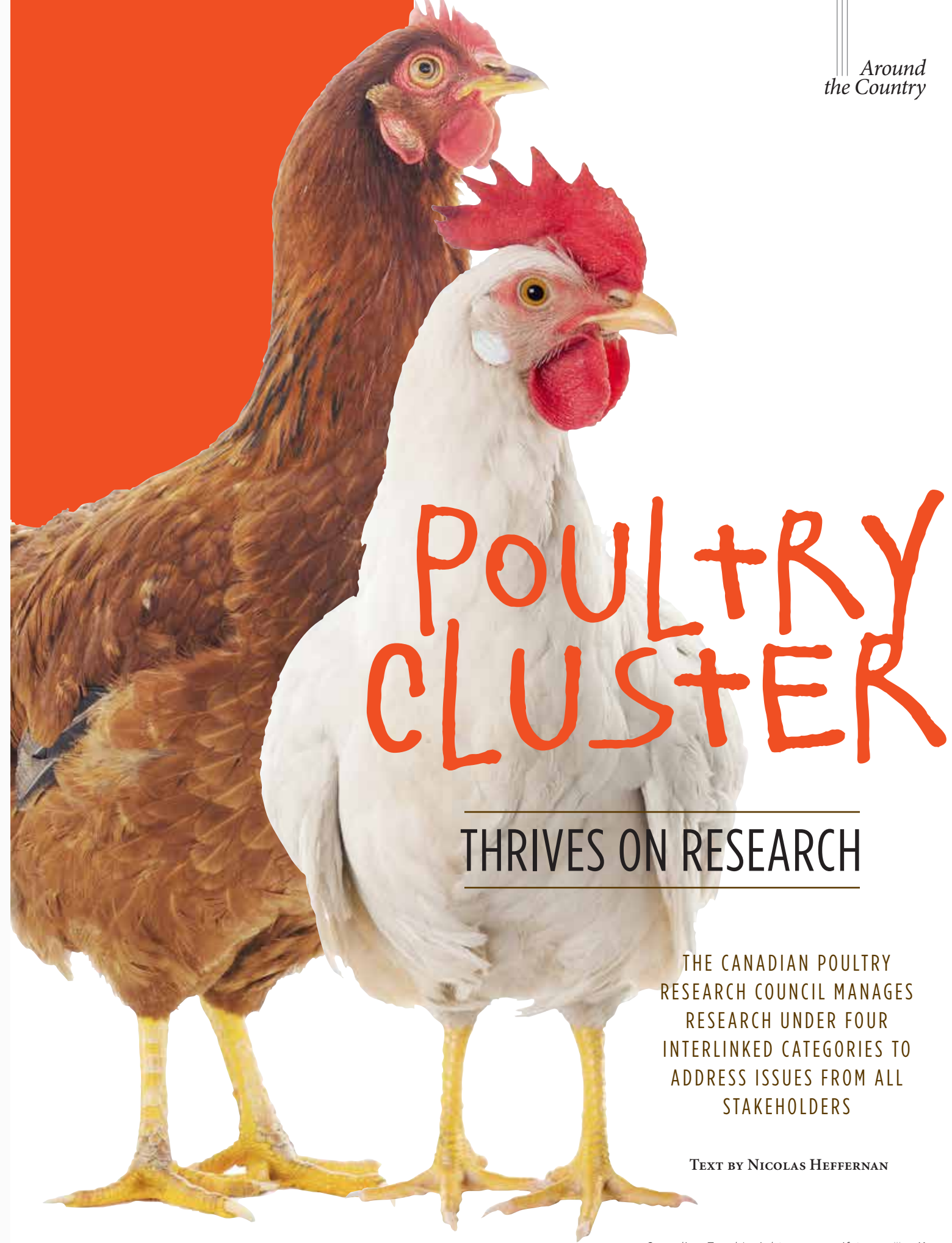
CONVENTIONAL APPLE

ARCTIC APPLE

[www.arcticapples.com](http://www.arcticapples.com)



[www.okspecialtyfruits.com](http://www.okspecialtyfruits.com)



# POULTRY CLUSTER

THRIVES ON RESEARCH

THE CANADIAN POULTRY  
RESEARCH COUNCIL MANAGES  
RESEARCH UNDER FOUR  
INTERLINKED CATEGORIES TO  
ADDRESS ISSUES FROM ALL  
STAKEHOLDERS

TEXT BY NICOLAS HEFFERNAN

THINK OF CANADA'S POULTRY CLUSTER AS A BIG WHEEL. The spokes are different research projects, funding mechanisms and communication channels that reach out to industry, academia and government. But at the centre of it all is the Canadian Poultry Research Council (CPRC).

"The CPRC acts as the hub of the wheel, but we have funding from something like 22 different industry organizations," says Bruce Roberts, CPRC's Executive Director. "It's mindboggling. There are about 35 to 50 organizations that are somehow feeding information into us about what's important to them for research from the producers' side. Then we have regular discussions with other companies like food companies, vet and medical organizations and breeder companies. And the universities also have direct contact with those same types of organizations and corporations."

This cluster is the second iteration of an original cluster which started with Growing Forward. Growing Forward Two allowed the CPRC to continue some projects, while gaining more funding and the ability to launch more projects that will last longer. The cluster gets three government dollars for every industry dollar. The poultry cluster is also a little bit different than others because the CPRC represents four national production organizations and one processing organization (Chicken Farmers of Canada, Canadian Hatching Egg Producers, Canadian Poultry and Egg Processors Council, Egg Farmers of Canada and Turkey Farmers of Canada), which support the cluster's research activities. "It gives us a different focus to a certain extent, makes it a little more challenging to address all of the allotted research concerns and requirements of our organizations," says Roberts. "The cluster, because of its size and dollar values that we're able to bring together, has already allowed us to address a lot of issues in research."

Indeed, the cluster supports 17 research activities conducted by 59 researchers from 24 organizations including 11 universities (four international); five government departments (federal and provincial) representing both agriculture and human health; and eight companies involved in poultry research. This is all done thanks to total funding of almost \$5.6 million, including industry contributions of \$1.45 million with the balance from government. Each research activity is led by a principal investigator from a Canadian university.

While it might get chaotic at times for Roberts, the research that this web of collaboration permits makes all the headaches worth it. "It allows us to do more than we would normally be able to do just because it's a program rather than just looking at individual projects," says Roberts. The cluster is developed under four main categories: poultry infectious diseases, alternative animal health products and management strategies, poultry welfare and well-being and environmental stewardship. "All of them are very much interlinked and address all the major issues we hear about from producers, consumers, government, health authorities," says Roberts. "We have a lot of research to do."



#### ANTIBIOTICS AND WELFARE

The two major issues facing the poultry industry and livestock in general are reducing the use of antibiotics and addressing the changing expectations around animal welfare. "Our big fear here is avian influenza," says Roberts. "We had one outbreak in British Columbia and they ended up having to recall over a million birds. It's just incredible what happens when you get something like that."

The cluster supports research on avian influenza vaccines, with some projects aimed at improving the innate immunity of the birds themselves so they can fight off the sicknesses without the need for as much medication. But it's a double-edged sword because as well as medication can work, constant and inappropriate exposure has led to the development of antimicrobial resistance. Roberts bristles at the thought of the majority of the blame been apportioned to medicine used in animals. "Most of that comes from human medicine," says Roberts. "Although it's easy to throw stones and not look in the mirror."

Nevertheless, the industry and researchers are realizing that something needed to be done. "Livestock agriculture in general got quite lazy when we figured out if we could just pump the drugs into the animals it took care of a lot of things without us having to worry too much about improved management," says Roberts. "Now society is looking at it and saying, 'Woah, woah, there are some downsides here.'"

The downside of resistant bacteria has seen the cluster fund ways of reducing the use of antibiotics and finding alternatives besides vaccines, including new management practices, and the study of epigenetics: why some birds adapt really well and some don't. This brings home the value of the cluster and the CRPC's role. About two months ago they had a meeting with the Agriculture Canada on how to cooperate on genomics research. "There are some things that will benefit poultry," says Roberts,

"and what resources Ag Canada has and then we can turn around and talk to the universities about resources you have and match them up. That's something that we do a lot of; trying to coordinate collaboration not just between government and a university but the universities themselves." On some projects there can be three and sometimes four different universities working alongside a government researcher. "That wouldn't happen without the cluster because we're looking at – at least for

The cluster receives total funding of almost \$5.6 million, including industry contributions of \$1.45 million with the balance from government.

poultry – larger and more comprehensive projects with a longer timeframe," says Roberts.

#### WORKING TOGETHER

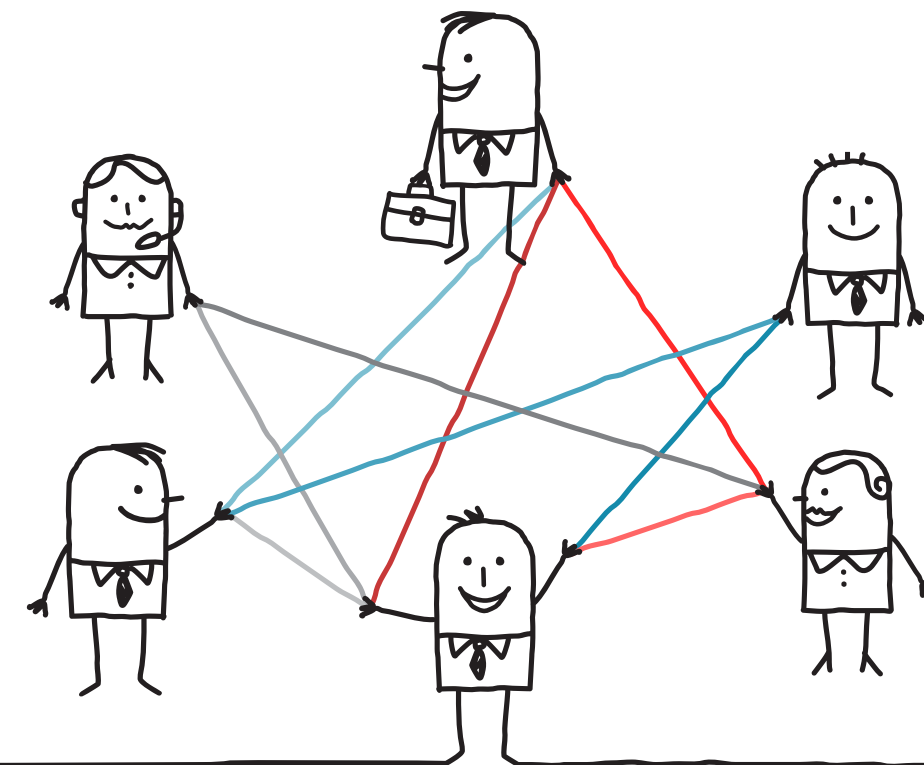
No matter what strand of research, the cluster should find success because of the input of the stakeholders. "[It's] what industry's priorities are, what the university researchers' priorities are and how we make those things come together. Government, I'm not sure what their priorities are," Roberts chuckles.

The cluster also allows research to be planned for the future. Standard funding is for two to three years, but as many as five. "The ones that go two years, they'll be out in the industry commercially or adopted by producers before the cluster is done," he says. "Other ones are a step forward in something that will make another cluster in another five years to bring to fruition. It is management-intensive for us as the recipient but it allows us to really think strategically and longer term. We're covering everything in the cluster that needs to be researched."

And the wheel keeps turning. ■

#### THE CLUSTER SUPPORTS

- 17** research activities conducted by
- 59** researchers from
- 24** organizations including
- 11** universities (four international);
- 5** government departments (federal and provincial) representing both agriculture and human health; and
- 8** companies involved in poultry research





**HOW “UNBAKED” ARE YOUR DESSERTS?**

My desserts are “unbaked” because they aren’t actually cooked in the oven. This means that nothing is heated above 118 F. They are 100 per cent sugar-free, dairy-free, gluten-free, vegan, and raw.

**WHAT ARE THE BENEFITS THAT COME WITH RAW FOOD?**

In raw food, all of the natural enzymes and nutrients remain intact. Not only is this beneficial to boost and help with digestion, but also helps to fight chronic disease. Growing up, I struggled with acne and stomach problems and raw food has played a significant role in clearing them up. My current diet is about 80 per cent raw, and I always find that when I’m eating raw I feel my best – both physically and mentally.

**WHAT ARE SOME SPECIAL INGREDIENTS THAT YOUR COMPANY USES?**

I think all of the ingredients we use are pretty special. Most are superfoods and have such amazing health benefits. Some of them include: cashews, coconut oil, cacao butter, raw cacao powder, and spirulina.

**WHO DO YOU GET YOUR BAKING AND BUSINESS INSPIRATION FROM?**

Typically, my inspiration comes from what’s in season. I absolutely love going to the farmer’s market on a Saturday morning and just letting the produce speak for itself. I also tend to recreate vegan and raw vegan versions of my favourite non-vegan desserts.

**WHAT WAS THE RAW FIRST DESSERT YOU EVER MADE?**

The first raw dessert I ever made was a raw vegan apple pie. It’s so simple, and still one of my favourite recipes to this day!

**WHAT’S THE WEIRDEST INGREDIENT YOU’VE EVER UNBAKED WITH?**

I’ve used some pretty strange ingredients but I’d have to say Irish moss takes the cake. Irish moss is a type of red algae that grows along the rocky parts of the Atlantic coast of Europe and North America. It’s the raw vegan version of gelatin and can be used in puddings, cakes, and sauces. ■



**UNBAKED CAKE CO. SERVES UP VEGAN SWEETS**

TEXT BY MICHAEL MARKOV

LIZ GALLAGHER IS THE DRIVING FORCE BEHIND UNBAKED CAKE Co. Unlike most pastry companies, Unbaked Cake Co. serves only raw, vegan, organic desserts.

The small Toronto-based business is the byproduct of Gallagher’s passion for healthy cuisine. After being introduced to raw food through a friend at university, Gallagher started making her own desserts for friends and family. Her spare time was spent in the kitchen trying out new recipes and it wasn’t long before she moved to the city for culinary school. She immersed herself into the vegan community, eventually working as the raw vegan dessert chef in a prominent restaurant. Shortly after leaving the restaurant, Unbaked Cake Co. was founded in 2013. Since then, the company has won multiple awards for its raw desserts and has initiated a Kickstarter campaign to raise funds for new equipment and business plans. Gallagher is aiming to grow her company throughout the greater Toronto area and eventually open a storefront.



Eppendorf’s BioSpectrometer® is ideally suited for testing and analyzing beer

“Light” Beer, Redefined

**Eppendorf BioSpectrometer and the brewing process**

Spectroscopy allows brewers to analyze the concentration and quality of substances in beer by measuring absorbance at wavelengths within the UV/Vis spectrum.

Eppendorf’s BioSpectrometer is a scanning spectrophotometer with flexibility for easy integration into the brewing process.

- > The BioSpectrometer establishes specifications to maintain consistency and quality in brews
- > Allows the brewer to test throughout the brewing process; removes the need to outsource testing
- > Protocols for beer analysis using the BioSpectrometer are available

[www.eppendorf.ca/beer](http://www.eppendorf.ca/beer) • 800-263-8715

# Sunflower Oil

Available in

## Two Premium Oil Choices

Give your products a wellness boost with heart-healthy sunflower oil.

Trans fat free, not genetically modified and an excellent source of Vitamin E, it's no wonder that 75% of Canadians<sup>1</sup> are interested in buying products made with sunflower oil.

Both **MID OLEIC** (NuSun<sup>®</sup>) and **HIGH OLEIC SUNFLOWER OIL** have:

- ✓ Superior stability and extended shelf-life
- ✓ A light, neutral taste, offering a clean flavour profile
- ✓ A longer fry-life<sup>2</sup> than other oils

**WATCH OUR VIDEO**



Find out why so many food manufacturers have switched to sunflower oil.

Call or meet with a sunflower oil supplier to determine which oil is right for your application:

ADM – 800-533-1250  
Brenntag Canada Inc. – 866-516-9707  
Bunge Oils (Canada) – 800-361-3043  
Caldic Canada Inc.\* – 800-263-1939  
Cargill – 800-263-5573  
C.P. Vegetable Oil Inc. – 800-431-3731  
Fazio Foods International Ltd. – 604-253-2668  
Hubbert's Industries Ltd. – 905-791-0101  
LV Lomas Ltd.\* – 905-458-1555  
Northern Alliance Commodities\* – 519-979-3800  
Sager Food Products Inc.\* – 514-643-4887  
Saporito Foods – 905-944-0505  
SunOpta\* – 888-210-2599  
TAKTIK Marketing – 514-389-2553

**\*Also sells Organic or Conventional Expeller-Pressed**



Buy USA Sunflower Oil | [www.sunflowerusa.com](http://www.sunflowerusa.com)

NuSun<sup>®</sup> is a registered trademark of the National Sunflower Association

1. Research conducted by IPSOS-ASI Ltd., January 2010

2. Fry study conducted by Cargill, Spring 2009.