Agriculture and Agri-Food Canada
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Strawberries to Get the Full Treatment

Tasty and good for you: strawberries are the whole package. Researchers at AAFC labs in Kentville, Nova Scotia, have big plans for this luscious fruit, a favourite among growers and consumers alike.

As more becomes known about the health benefits of colourful fruits such as strawberries, the market for these products continues to grow. This brightens the outlook for strawberry growers, who continue to see welcome returns on their operations.

To help keep strawberry production profitable, researchers are mobilizing on a number of fronts. First and foremost, they aim to top up the gene pool with strawberry plant germplasm to help develop varieties adapted to all agricultural regions in Canada. This will help strawberry breeders address any issues triggered by possible climate change.

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In addition to broad adaptability, the research team is looking to improve fruit quality, specifically by identifying genotypes with the optimum balance between sugars, acids, and flavour intensity. By combining excellent flavour with improved firmness, scientists hope that Canadians will be encouraged to buy more local strawberries that they can count on for their consistently high quality.

Strawberry growers wage a constant battle with various plant pathogens. Scientists at Kentville are assisting growers by building in genetic resistance to several pathogens. One example is germplasm resistant to angular leaf spot, a bacterial disease of strawberry that has quarantine implications as well.

In recognition of the growing market for organic produce, scientists will engage in studies to determine the impact of organic production systems on root health and vigour as it relates to plant performance.

Finally, scientists will focus on identifying and characterizing germplasm tolerant to the black vine weevil. Serious infestations of this pest can shorten the profitable lifespan of a strawberry field by sometimes as much as half.

The expected outcome of all this research is improved cultivars and new knowledge that will benefit all Canadians by improving the quality and lengthening the season for domestically grown strawberries. It will benefit growers, both conventional and organic, by reducing production costs, expanding market opportunities, and reducing business risk. And it will benefit consumers by offering a quality product contributing to a health-promoting diet.

Canada

Food for Health

The association between food and health has been observed long before it could be quantified. And now, thanks to science, rapid progress on this front has been exponentially expanding our knowledge of the relationship between food components and health benefits. Here at Agriculture and Agri-Food Canada (AAFC), our scientists are part of this effort aimed at unlocking the secrets of food functionality on human health.

We consider this research direction to be of prime relevance to today's agri-food science needs. And this view is shared by the industry, according to extensive cross-sector consultations. These consultations have furthermore allowed us to establish seven research priorities of national importance where AAFC will play a leadership role. The first of these priorities is the enhancement of human health and wellness through food, nutrition and innovative products.

By studying the composition and functional properties of food at various stages along the value chain, we can help develop new crop varieties, food products, nutraceuticals and other innovative health related products that have the potential to enhance human health and wellness. At AAFC, we use scientific knowledge to understand the nutritive components of specific foods and their mode of action in disease prevention, health and wellness in support of the production of healthy products.

This work is of great importance to Canada for a number of reasons. The health of Canadians is an obvious benefit. Moreover, this work also paves the way to innovative new products and processes for the agri-food industry to bring to market to meet growing consumer demands. And fractionation and extraction processes allow for the production of compounds in quantity and of purity necessary for clinical trials to learn more about their health properties.

These are exciting times for food science. We look forward to working with Canada's food industry to provide healthy products for today and beyond.

Marc Fortin, Assistant Deputy Minister, Research Branch, Agriculture and Agri-Food Canada

Cherry Deal Sees Many Happy Returns

An award-winning business arrangement between Agriculture and Agri-Food Canada's Pacific Agri-Food Research Centre (PARC) and the Okanagan Plant Improvement Corporation (PICO), both based in Summerland, B.C., has spurred a sweet cherry renaissance in the province. The collaboration has led to a huge spike in the value of B.C.'s cherry exports, which skyrocketed over a fifteen year period from around $1 million in 1994 to over $21 million in 2007.

Together, these two organizations have created a high-speed connection that brings cherry innovations to the marketplace. The success of this union recently garnered an "Excellence in Technology Transfer" award from the Federal Partners in Technology Transfer earlier this year.

The PARC-PICO team is a win-win situation for all concerned –scientists, growers and industry. It accelerates the transfer of new cherries from the lab to the orchards and provides an opportunity for direct industry feedback on market priorities.

Further attesting to the success of the program, about 90 per cent of new acreage of cherry tree plantings in B.C. since 1994 is to PARC varieties.

Building on its longstanding commitment to B.C.'s cherry industry, PARC has developed sweet cherry germplasm that is attractive to today's growers and consumers alike. Fruit quality is of course key, but even more value is added by self-fertility and late maturity. These two attributes mean that fruit is set even when springs are cooler than usual, and that new, late-season markets can be tapped when conventional sources have disappeared from retailers' shelves.

Varieties developed by the PARC breeding program have allowed local growers to gain a reputation in the world market place as producers of high quality cherries. And consumers can enjoy fresh Canadian cherries just a little bit longer!

Blueberries Leave Indelible Mark on Good Health

Apples may have to give way to blueberries in the role of keeping the doctor away. Scientists continue to uncover more evidence that supports a recommendation to take a daily dose of blueberries, a rich source of compounds with arrestingly diverse health benefits.

It's in large part due to their colour, according to food researchers at Agriculture and Agri-Food Canada's (AAFC) Atlantic Food and Horticulture Research Centre in Kentville, Nova Scotia, where they've been focusing a scientific lens on the nutritive qualities of blueberries for some time now.

This work heralds a new approach to food science at AAFC, namely, the study of linkages between specific food compounds and human health. Developing this knowledge will allow producers to select appropriate varieties, find new business opportunities and adopt health marketing strategies, and will help consumers make better-informed choices about their food.

In studies ranging from neuroscience to cardiovascular health, the evidence is strongly in favour of the health functionality of blueberries.

The blueberry family (Vaccinium in botanical parlance) has long been associated with good health. Its medicinal uses were noted in mediaeval times, but the science behind the claims is much more contemporary. Studies from Europe in the 1960s and '70s focused on blueberries' potential benefits to blood vessels and eyes, but by the mid 1990s, public interest in antioxidants began to drive research directions.

Scientists were intrigued by the effects, and especially the antioxidant effects, of a group of compounds called phenolics, including flavonoids, and especially the colourful anthocyanins.

Anthocyanins are the pigments found in many fruits and vegetables like red grapes, red cabbage and red onions, but are particularly abundant in blueberries. They come in reds, blues and purples and are the reason you don't want to spill red wine on your white shirt.

But stain potential aside, blueberries have such a catalogue of health benefits that it's worthwhile to add it up. Citing research from 'test tube' and animal studies, scientists point to blueberries' anti-inflammatory properties, their ability to delay the onset of age-related decreases in cognitive and motor function, provide some possible Parkinson's disease protection, aid in ischemic stroke recovery, and help reduce cholesterol and prevent colon cancer.

Biomedical evidence continues to mount in support of blueberries as a boon to health, and the Kentville scientists are making efforts to further shore it up. They've made a key contribution by developing procedures to isolate the specific blueberry flavonoids to determine which of these compounds may be responsible for particular health benefits.

Thanks to fractionation technologies coming from this research, scientists have also been able to better profile the composition of the fruit. Studies also continue to evaluate the effects of growing conditions, handling, and processing on the berries' bioactive flavonoids.

Moreover, the team has managed to scale up the flavonoid fractionation process to produce the quantities needed for animal feeding studies. Evidence from animal feeding studies provides stronger evidence for physiological effects as compared to the small- scale 'test tube' (*in vitro*) studies, where these flavonoid fractions had previously been studied.

A human clinical study has just wrapped up in collaboration with Dalhousie University in Halifax that follows up on earlier research from Europe. The focus was on night vision, specifically to determine whether and by how much blueberry compounds could influence aspects of night vision in humans with normal vision. The results are being tabulated prior to submission for journal publication.

Another interesting study has recently been completed in collaboration with the Atlantic Veterinary College in Charlottetown, Prince Edward Island. Here researchers looked at the impact of blueberries on cholesterol levels. They observed that pigs fed a diet high in sugar and fat experienced a decrease in cholesterol levels when blueberries were added to the rations.

But the effect was more dramatic when the blueberries were added to a more sensible plant-based diet, suggesting that the benefits from blueberries come from a synergistic interaction with other plant compounds.

Even though there are obvious benefits from eating blueberries, researchers caution that these things can't be taken in isolation. Having a lot of blueberries in the diet is great, but they should be part of a balanced diet rich in a variety of fruits and vegetables.

Growing Canadian Agri-Innovations Program a Boon to Science

If the road to innovation travels through science, then Canada's agri-food sector just got four new on-ramps. The Growing Canadian Agri-Innovations Program offers a quartet of initiatives to help to build an innovative and competitive agricultural sector by encouraging industry leadership and investment in agricultural science and innovation. The program is part of Growing Forward, a commitment to Canada's agriculture sector by federal, provincial and territorial governments to work together and share the costs of building the productivity, profitability and competitiveness of the Canadian agriculture industry.

Governments are investing $1.3 billion over five years into Growing Forward programs. The funding is cost-shared on a 60:40 basis between the Government of Canada and the provincial and territorial governments.

The initiatives under the Growing Canadian Agri-Innovations Program are:

Agri-Foresight, which will help the agricultural sector anticipate possible future challenges and opportunities. Partners and stakeholders will anticipate, plan for and take leadership by developing innovation strategies for enhanced profitability.

Canadian Agri-Science Clusters, aimed at helping key industry-led agricultural organizations to pull together national scientific and technical resources to establish clusters that support innovation for enhanced profitability and competitiveness. Encouraging industry leadership and investment in Canadian Agri-Science Clusters will reduce the time needed for new products, practices and processes to reach the market.

Developing Innovative Agri-Products, to support industry-led science and technology projects that bridge the gap between ideas and discoveries and products in the marketplace. These investments will pay off as innovation creates new economic opportunities for farmers, agri-businesses and communities.

This initiative includes two streams:

- **Innovation Strategy Development** to support collaboration and planning by stakeholders to create and expand agriculture, agri-food and agri-based value chains that will develop new innovative opportunities.
- **Implementation of Applied Science, Technology Development and Piloting Projects** to transform innovative ideas into new agri-products, practices and processes by helping the sector access applied science research and development resources.

Promoting Agri-Based Investment Opportunities, intended to create linkages that encourage private investment in the development of innovative agricultural products, practices and processes by bringing together and encouraging networks of potential investors and agri-entrepreneurs.

As these initiatives are taken up by the sector, Innovation Express will feature stories and other updates on the program. And for more information on any Growing Canadian Agri-Innovations Program initiatives, please contact us at:

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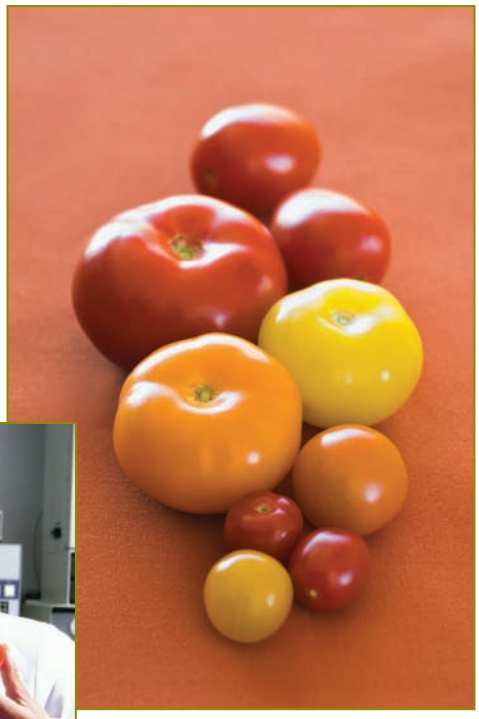
Lycopene in Tomatoes for Health

What puts the red in tomatoes is also recognized to be a factor in the protection against cancer and other diseases. Lycopene, dubbed "the world's most powerful antioxidant", is the subject of a wide-ranging research project at AAFC's Guelph Food Research Centre. Scientists are studying the compound to better understand its stability and bioavailability, and to develop practical applications leading to new opportunities for tomato producers.



Lycopene is a lipid-soluble antioxidant pigment that is synthesized in many plants but not by humans or other animals. It is especially prevalent in tomatoes, and its bioavailability can actually be enhanced by processing.

Since most of the lycopene in tomatoes is found in the skin or just below, a lot of it ends up in the waste bins of processing plants. Researchers are looking to mine this source for value-added products.

Their first step is to understand how lycopene interacts with other health-promoting components in human diet, based on synergistic effects on antioxidative and other health benefits.

A further tack is to develop and evaluate energy-efficient and cost-effective "green" processes of extraction, separation and concentration based on such technologies as supercritical fluid extraction, pressurized lower polar water extraction, molecular distillation, and membrane technologies to obtain high yields and intact bioactivity of lycopene-rich extract from tomato waste materials. These extracts, free of any toxic chemical residue, could then be used for functional foods, health-promoting ingredients and nutraceuticals.

Scientists are also aiming to study and evaluate the effects of processing and storage conditions on the stability of lycopene and other similar pigments in tomato products. They are also seeking ways to stabilize bioactivity or minimize the degradation of these pigments, as well as other bioactive compounds in tomato products, by designing processing methods and optimizing processing conditions.

A further goal is to commercialize the applications of lycopene-rich extract as functional food ingredients and to fortify tomato-based food quality. Researchers are also training their sights on developing optimum formulations for tomato-based food according to synergistic effects of lycopene, β-carotene, vitamin E, vitamin C and some polyphenols.

And finally, the study team will look for ways to promote lycopene accumulation during the tomato maturing process through organic agricultural practice. The net result of these studies will be greater opportunities for the food industry to incorporate lycopene into food products, and more choices for consumers looking to capitalize on its health benefits.

Probiotics Add Culture to Dairy Products and More

Probiotics research at Agriculture and Agri-Food Canada's (AAFC) Food Research and Development Centre in Saint-Hyacinthe, Quebec, is helping shed light on both the nutritional and practical aspects of these beneficial bacterial cultures. Scientists there are working with industry, universities and clinical researchers to help bring to market innovative food products with enhanced and properly understood health attributes.

Probiotic cultures are beneficial bacteria that occur naturally in the digestive system of animals and humans and help keep the bad bacteria and other microorganisms at bay. Normally the friendly bacteria dominate the gut, but stress, antibiotics or poor food choices can upset the body's natural balance. Consuming sufficient quantities of probiotic cultures helps restore this balance in the intestine, improving the health of our digestive system and even our immune system.

A research team made up of experts in human nutrition and metabolism is examining how food and basic food components, such as probiotics, affect the balance of good and bad bacteria in the intestine and the intestine's role in nutrition and health.

This research focuses on the events and conditions in the gastrointestinal tract, a key link between what we eat and our health and wellbeing. The goal is to gain a better understanding of how our food is digested, metabolized, and contributes to the immune and disease control processes so that people may achieve optimal nutrition and health. A significant aspect of this research involves developing the science to support health claims for food and food components.

But introducing probiotic cultures into food products is not as easy as one might think. Live cultures behave very differently according to the material they're mixed with. Researchers want to make sure the probiotics they add stay viable and survive in sufficient numbers to provide the intended health benefits.

AAFC researchers are looking at three probiotic encapsulation methods and examining how they interact with food products such as frozen yogurt or breakfast cereals. Micro-encapsulation holds promise as a way to stabilize the probiotic cells during food processing and storage. This technology may also help cells survive in the gastro-intestinal system, and support the release and growth of probiotic cells.

These two lines of enquiry – one to develop innovative encapsulation technologies to ensure probiotic viability in foods, the other to see how these innovations affect the functionality of probiotics in the intestinal system – will converge to have a positive technological impact on Canadian probiotics producers and food manufactures. The research will go a long way toward standardizing the health effect of probiotics in food, which will benefit consumers and help government officials more effectively assess the health claims of food products containing them.

Pork Gets Omega-3 Boost

As the popularity of omega-3s continues to grow, Agriculture and Agri-Food Canada (AAFC) scientists are working on a number of fronts to boost the availability of this nutrient in various foods, notably pork.

Omega-3 fatty acids are associated with heart health, and may also improve the immune system and reduce the risk of developing some cancers. One of the richest sources of plant-based omega-3 is flax. Feeding flax to animals is a proven way of boosting the omega-3 content of meat, eggs or dairy products.

To capitalize on this, AAFC scientists are working with the University of Alberta and the Prairie Swine Centre in Saskatoon, Saskatchewan, to develop a successful flax seed feeding program to enrich pork with omega-3 fatty acids and evaluate the quality and acceptability of pork end-products.

But feeding diets containing flax seed to pigs is not a straightforward process. There are limits to the level and duration that flax can be fed before it starts to have a negative impact on animal growth and feed utilization. And while feeding flaxseed to pigs enriches omega-3 fatty acids in pork, levels of omega-3 fatty acids can differ from tissue to tissue and higher levels can lead to issues with pork processing, quality, palatability and oxidative stability.

Scientists are looking to determine the best feeding practices that would enrich pork cuts with sufficient levels of omega-3 fatty acids required to claim enrichment, which is currently pegged at 300 mg per 100 g of pork. They are also hoping to establish the optimal start and finish weights for pigs to achieve desired levels of omega-3 fatty acids.

On another front, scientists are examining ways to enrich pork by feeding pigs algae high in omega-3 fatty acids. The omega-3 in algae is known as DHA, the kind found in fish oil. They're also trying to raise levels by injecting a brine solution of food grade DHA into fresh pork loins. The goal is to reach 100 mg DHA per 100 g serving of a pork chop.

Their research has established that bacon made from pigs fed up to 20 g of DHA per day is acceptable according to a limited marketing survey. Also deemed acceptable were pork loins injected with 100 mg DHA in a brine solution as compared with loins injected with sunflower oil. The researchers note that further work is needed to improve the oxidative stability of these products.

Other work down the road will compare the effect of pure DHA with the mixture of omega-3 oils from fish extracts and various anti-oxidants, as scientists continue to seek innovative ways to integrate omega-3 fatty acids into the food we eat.

This research has received funding from the Saskatchewan Agriculture Development Fund and Flax 2015 and through the Agriculture and Agri-Food Canada peer review process.

Initiative to Modernize AAFC Labs

From new dairy barns to greenhouses, gene depository, growth rooms and specialty research labs, here's some welcome news – seven research centres at Agriculture and Agri-Food Canada (AAFC) are benefiting from a series of projects to modernize federal laboratories in Canada.

The improvements to the labs will enhance AAFC's research capabilities in plant breeding, pest management, and dairy cow management and help keep scientists on the cutting edge of research. Ultimately, these improvements will also assist Canadian farmers and industry who benefit directly from research conducted at federal laboratories.

The Modernizing Federal Labs Initiative is part of Canada's Economic Action Plan, announced in Budget 2009. In it, the federal government committed to an accelerated investment program to provide $250 million over the next two years to address deferred maintenance at federal laboratories.

Here's the list of projects awarded to AAFC's research centres.

Crop and Livestock Research Centre in Charlottetown, Prince Edward Island is getting $5.434 million to modernize its greenhouse facilities at the Charlottetown site with a large greenhouse and a header house (a large, open work area next to the greenhouse) at the Harrington field research site. The new facility will enhance the research capabilities of scientists doing work with insect populations, plant breeding, health research on plants, and other groundbreaking work in the bioscience sector.

Potato Research Centre in Fredericton, New Brunswick will see $500,000 for the construction of a new potato gene facility that will enhance potato research capabilities. The retrofitted building will store the country's entire range of potatoes, from newly developed to heritage varieties. The repository will meet international standards by providing a controlled climate and the required space and security needed to protect them. With the complete collection at their fingertips, researchers will be able to excel in the development of new potato varieties for targeted markets, pest control, soil and water management, potato genomics and processing.

Dairy and Swine Research and Development Centre in Sherbrooke, Quebec will put $12 million towards building a new dairy complex. The funding for the research centre will be used to construct a 6,000m^2 dairy research complex to allow effective research in dairy food safety and nutrition. Over the long term, this investment will allow for research in the dairy sector to support the sector's competitiveness.

Horticulture Research and Development Centre in Saint-Jean-sur-Richelieu, Quebec will invest $350,000 to modernize the pesticide testing laboratory. The investment will allow for the renovation of the existing laboratory to better support pesticide research, leading to new alternatives for farmers. This upgrade will enhance the capabilities of research being done under the Minor Use Pesticide Program of Agriculture and Agri-Food Canada and Health Canada's Pest Management Regulatory Agency (PMRA).

Guelph Food Research Centre in Ontario will invest $1,150,000 to upgrade an existing pilot plant that helps develop better food processing techniques. The pilot plant facility will partner with federal departments such as the Canadian Food Inspection Agency (CFIA) and universities to validate the safety of food processing, and test innovative processing technologies for producing safe foods. The renewal of this facility will also help improve food processing regulation in collaboration with CFIA, and collaborative research with the Health Protection Branch of Health Canada.

Morden Research Station in Manitoba is going to use $250,000 to modernize the growth control room used by scientists to develop a new type of wheat that is resistant to a wheat stem rust that has the potential to devastate wheat crops. The Morden Research Station is responsible for conducting research that helps farmers meet the needs of a changing marketplace, as well as the expectations of Canadians and world-consumers for the high quality and safe food Canada is known to produce.

Semiarid Prairie Agricultural Research Centre in Swift Current, Saskatchewan will invest $5 million over the next two years to update its greenhouse facility with a 700m^2 replacement structure to allow researchers to effectively ensure the safe entry of new food and feed products and processes to the marketplace. This research is in collaboration with the Canadian Food Inspection Agency and Health Canada to develop new standards for innovative food products and processes.

Several of these projects are already under way and the benefits are expected to be felt shortly.

Cherries Offer Antioxidant Product Potential

Firm, ripe market-fresh cherries are loaded with antioxidants, which make them an excellent complement to a balanced diet. But as growers know, not every cherry will make it to market. The culls, typically the cracked or small cherries, are rejected by consumers and represent a lost opportunity for growers. They turned to AAFC scientists in Summerland, B.C., for help. And it looks like researchers have found a potential reversal of fortune for these underachieving cherries by identifying new value-added opportunities for them.

The market for antioxidant–rich products has been steadily increasing owing to their impressive list of health benefits, leading researchers to investigate cherry culls as a possible source of antioxidants.

Fresh cherries are known to be sufficiently rich in antioxidants, but scientists wanted to determine whether the splits and smalls have corresponding quantities. Researchers also sought to discover whether the variety of cherry had any impact on the antioxidant level.

The research project focused on sweet cherries of economic importance to the Okanagan and Kootenay cherry growing regions of British Columbia. The selected varieties all came from the AAFC cherry breeding program, which is no surprise, as these cherries are the backbone of the B.C. industry (see Cherry Deal Sees Many Happy Returns p. 2). The varieties examined were Lapins, Skeena, Staccato, Sweetheart, and Sentinel.

Researchers took samples of both fresh-market grade and culls and measured both the antioxidant content and activity of each sample. They discovered that the antioxidant activity level for all samples was relatively high, but there was some variance between the cultivars. Variability can also be attributed somewhat to location and management practices.

Whatever marketing deficiencies the culls may show, they have no lack of antioxidants or antioxidant activity when compared to the higher grade fruit. And with an average of 500 to 600 tonnes of cull cherries available annually in the Okanagan, there is an excellent opportunity to develop them as a source for value-added antioxidant-rich products. Scientists are looking to further research in the technological and commercialization aspects of antioxidant-rich products from cull cherries.

The project was conducted in collaboration with the B.C. Fruit Growers' Association and the National Research Council's Industrial Research Assistance Program.

Tell Us What You Think

Innovation *Express* is the Research Branch of Agriculture and Agri-Food Canada's quarterly newsletter to promote research partnerships and technology transfer to organizations interested in agri-food research and development.

We welcome your comments and suggestions.

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