A natural process for a natural product

Extraction research for cancer-fighting lycopene holds promise for other nutraceuticals

With the growing interest in functional foods designed to reduce cancer risks, drugstores can hardly keep enough of the popular antioxidant lycopene on the shelf. But current lycopene extracts are simply dried tomato skins, low in purity. That's led University of Guelph physics research associate Bruno Tomberli and University of Alberta food science professor Feral Temelli to try using a form of carbon dioxide to improve lycopene extraction processes.

"This solvent has a high probability of extracting greater amounts of lycopene," says Tomberli. "And unlike other solvents used today, it won't leave behind any unwanted potentially toxic residue."

The carbon dioxide they're using is the same type humans exhale, except it's warmer and under high pressure. In this state, carbon dioxide is called a supercritical fluid (SCF) because it's been taken to a temperature and pressure above what's called the critical point, where there's no longer a difference between a gas and a liquid.

For carbon dioxide, the critical point is 31 C and 73 atmospheres (73 times normal atmospheric pressure). Here, carbon dioxide behaves more like a liquid and can get into a tomato skin and dissolve the lycopene. As a gas, carbon dioxide can penetrate the skin of a tomato, but it's too light to grab on to the lycopene and carry it away. As a SCF, it's denser and has the ability to successfully relocate the lycopene.

The proposed method of getting lycopene out of tomatoes is even simpler than conventional extraction techniques. When conditions are right — that is, anywhere above the critical point — the lycopene gets taken up by the carbon dioxide. From there, the researchers reduce carbon dioxide's pressure so that it behaves like a gas again. It then loses the ability to hold on to the lycopene, which literally falls out in solid form. This can then be collected and made into high-purity tablets.

The percentage of lycopene in the extract can be increased by dehydrating the tomato skins prior to the procedure. The researchers are also looking at other solvents that increase lycopene's ability to be taken up by SCF.

(Left to Right) Bruno Tomberli, Selma Guigard, Feral Temelli and Marleny Saldana are using new methods to extract lycopene from tomatoes.

Although their current research is focused on lycopene, Tomberli says it won't stop there. Increasingly, health-conscious consumers are demanding natural products and natural extraction techniques. Current conventional solvents, most of which are petroleum-based, can leave residues on the extracted products and can pose environmental problems such as leaks and harmful emissions. Temelli says supercritical carbon dioxide could help replace the petroleum-based solvents being used in food processing today.

Health-conscious consumers are demanding natural extraction techniques.

What's more, new extraction methods could provide an economic boon for Canada, one of the world's major tomato-producing countries. Currently, tomato-processing plants and ketchup manufacturers often discard tomato skins as waste. An effective large-scale lycopene extraction method would add value to these skins, reduce disposal costs and, most important, help everyday Canadians who are trying to eat healthy.

Tomberli, along with University of Guelph professors Saul Goldman and Chris Gray, is focused on extraction theory and fundamentals. Temelli, working with University of Alberta professors Selma Guigard and Suresh Narine and post-doctoral researcher Marleny Saldana, is primarily involved in experimentation.

This research is funded by the Advanced Foods and Materials Network.

Flower power

Marigolds give new boost to nutritionally enriched eggs

Canadians at risk of developing vision problems such as macular degeneration and cataracts should be seeing more yellow on their dinner plates, says Prof. Steve Leeson of the Department of Animal and Poultry Science. He's putting lutein, a yellow pigment that improves eye health, into eggs. And he's getting that pigment from a truly natural source: marigolds.

Lutein is one of the pigments that give egg yolk its yellow-orange colour. At high levels, such as six to eight milligrams a day, it actually helps prevent cataracts and macular degeneration — permanent physical damage to the central vision portion of the eye — which affects 30 per cent of people over 60.

Currently, the average daily lutein intake sits at less than half a milligram a day. But Leeson says preliminary studies suggest that feeding high levels of lutein to chickens will produce eggs with healthier levels for human consumption.

"Lutein is found naturally in spinach and most potently in the petals of marigolds," he says. "Spinach isn't a high priority on many consumers' menus, so if we can significantly improve the lutein content in eggs, it would be easier for Canadians to naturally consume their recommended daily intake."

The average Canadian consumes 200 eggs a year, including those added to recipes of processed and prepared foods. Currently, eggs contain one third of a milligram of lutein. Leeson hopes that by adding pure lutein from processed marigold petals to chicken feed, hens will produce eggs with much higher lutein levels. Ultimately, Leeson hopes to combine the findings into a super egg, based on the success of the team's Omega-3 eggs.

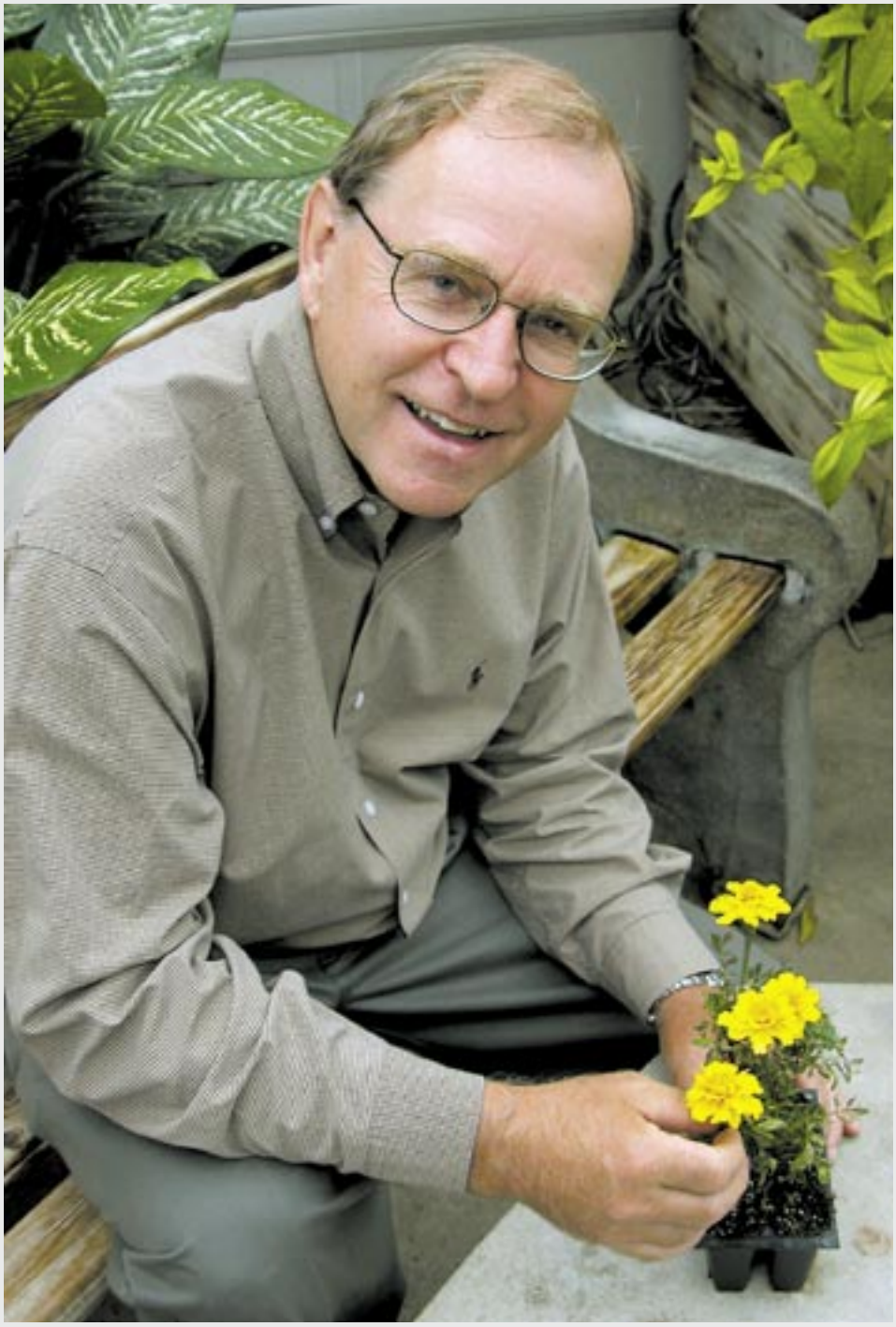
Omega-3s are fats that are recognized by Health Canada as heart-healthy compounds and also play an important role in mental health and visual functions. Omega-3 eggs, which are products of chickens fed feed with flaxseed, hit store shelves in 1996. They now account for five per cent of Canada's egg market and four per cent of eggs sold in the United States.

Omega-3s in flax are converted in the body to docosahexaenoic acid (DHA), which Leeson says is "the best of the Omega-3s." The team also has plans to produce Omega-3 eggs that are rich in DHA (achieved by feeding chickens fish oil), once labelling regulations are sorted out.

"Eventually, we'll produce an egg that is enriched with lutein, DHA and flax Omega 3s," he says. "If we can put the nutrients people need in the food they eat, we'll have a healthier population."

This research is sponsored by the Natural Sciences and Engineering Research Council, the Canadian Egg Marketing Agency, Egg Producers of Ontario, Roche Canada and Kemin Industries.

Prof. Steve Leeson is putting lutein — a yellow pigment found in marigolds that boosts eye health in humans — into chicken feed to produce lutein-rich eggs.



Getting soy into our systems

New research puts functional soy component right in the breadbasket

Soy has rapidly risen to the pantheon of functional foods — in large part due to its high level of isoflavones, a compound that helps reduce risk of heart disease and certain types of cancers. In spite of this knowledge, many people are put off by soy's distinctive taste, which keeps them from enjoying its health benefits.

Enter University of Guelph Prof. Alison Duncan, Human Biology and Nutritional Sciences. She has assembled a team of researchers to bring soy's health benefits beyond soy foods, by incorporating isoflavones into everyday staple foods. They're starting with isoflavone-enriched bread.

"We want to introduce newly developed foods that would provide consumers with more options to increase their intake of soy isoflavones" says Duncan.

There are four phases in this project. First, Duncan and her team will grow and harvest soybean plants with low, medium and high isoflavone levels. Next, the researchers will use the soybeans to produce breads with three different levels of isoflavones. Third, they will monitor human subjects as they consume the breads in order to evaluate how well the isoflavones are absorbed into the body by testing their levels in biological fluids, such as blood and urine. And finally, economic and consumer choice evaluations will be conducted to gauge the public's interest in this kind of isoflavone-enhanced product, and to see if it's economically viable.

Everyday foods such as bread could soon be enriched with the health-enhancing components of soy thanks to new research at the University of Guelph.

This research is unique, says Duncan, because it covers plant agriculture, food product development, nutritional science, natural product chemistry and agricultural economics — a truly multidisciplinary effort that takes soy research from the field to the consumer.

"One of the most exciting parts of the project is that it brings different disciplines together," she says. "We're all interested in soybeans in some way, but each from a different standpoint, and in working together we create an interesting approach to our research."

The researchers aim to complete their studies by 2008.

Duncan is collaborating with Prof. Istvan Rajcan, Plant Agriculture, Prof. Massimo Marcone, Food Science, Dr. Rong Cao, Agriculture and Agri-Food Canada, Prof. John Cranfield, Agricultural Economics and Business and Dr. Al Mussell, The George Morris Centre. This research is funded by the Food Research Program of the Ontario Ministry of Agriculture and Food (OMAF).

Enhanced foods for enhanced health

Eating fish, such as salmon, is known to give the heart and brain a boost. And milk is heralded for building strong bones and teeth. Now, the benefits of both of these foods can be found in one — that is, omega-3 enhanced milk.

U of G Prof. Bruce Holub, Department of Human Biology and Nutritional Science collaborated with Prof. Brian McBride and graduate student Tom Wright, Department of Animal and Poultry Science, to enrich conventional milk with decosahexaenoic acid (DHA), an omega-3 fatty acid that boosts human health.

Despite the emphasis on reducing dietary fat intake in Canada, our bodies do need some fat. In particular, DHA is needed in the eye and brain for optimal visual performance and mental functioning. DHA is important for development all through life.

"DHA is known to improve eye and brain development," says Holub. "It is especially important for development in children, and pregnant and lactating women."

There is also growing interest in the cardiovascular benefits of eating DHA-rich diets. Recent studies show that as DHA consumption increases, the risks of cardiovascular disease go down, possibly because of DHA's effect in regulating heart rhythms. And new evidence indicates that increasing DHA intakes can help modify stress-induced anxiety disorders and aggressive behaviours.

Where does DHA come from? Holub says fish is an ideal source of DHA, but some consumers are reluctant to eat fish because of odours, bones or perceived contamination. The customized feed that the Guelph researchers developed provides for the natural enrichment of DHA in cows' milk at significant levels and has led to a commercial product now available on supermarket shelves.

U of G researchers are also developing animal feeds that boost the omega-3 fatty acid content in eggs and meat.

Exercise: good for the heart, good for the soul

Physical activity levels often decline as children enter the teen years and a University of Guelph researcher is trying to determine why.

Nothing gives children a healthier glow than a rousing game of soccer or hide-and-go-seek with neighbourhood playmates. But emerging patterns of inactivity among teenagers have a University of Guelph researcher worried about the impact this could have on the physical and mental health of Canada's youth.

Prof. John Dwyer, Family Relations and Applied Nutrition, found a trend of decreasing physical activity when comparing 13- to-18 year-olds in a national phone study. He also conducted focus groups in Toronto high schools and found that psychological factors play a key role in explaining why 14 and 16 year-olds are physically inactive.

"Once we identify the barriers to physical activity," says Dwyer, "we can take steps to overcome them. We can develop and offer programs that adequately deal with some of these barriers."

Since 1981, the number of obese children in Canada has tripled. This has serious implications for the health care system, and the well-being of the children. Non-active youth are more prone to stress, low self-esteem and depression. Although teens know exercise is important, many choose to be inactive — and Dwyer wants to know why.

He believes that self-efficacy — the belief in one's own abilities — is a main determinant of a teen's activity level. The focus groups revealed that students often blame lack of confidence for their inactivity. For example, many students don't participate in school sports because they fear they lack the skills needed to make a team. Dwyer says these results suggest that many adolescents might be more active if there were more non-competitive programs offered that emphasize fun and skill development.

Youth often blame lack of confidence for their physical inactivity.

Many teenagers said they don't have enough time to exercise, citing schoolwork, household chores and part-time jobs as the major deterrents. But Dwyer is sceptical: he speculates that it's more of a priority issue than a time issue. Teenagers often choose to spend leisure time watching television or browsing the Internet, instead of pursuing pastimes that are more active.

To help encourage activity in youth, parents of very young children should moderate the time spent in sedentary activities, says Dwyer. When children become teenagers, parents can best influence their children's choices by being positive role models, such as limiting the amount of time they themselves spend watching TV.

In the future, Dwyer plans to track individual teens over a longer period to determine if barriers to physical activity and levels of physical activity change over time.

Dwyer's research is funded by the Social Sciences and Humanities Research Council and the Heart and Stroke Foundation of Ontario. More information about this research is available at http://www.phs.utoronto.ca/activeyouth/.

Focus on Food and Health is written by student participants in SPARK (Students Promoting Awareness of Research Knowledge), Office of Research, University Centre, Room 437, University of Guelph, Guelph, Ontario N1G 2W1 >> Phone: 519.824.4120 Ext. 58278 >> Fax: 519.821.5236 >> Website: www.uoguelph.ca/research >> Editor: Owen Roberts >> Editorial Co-ordination: Marianne Clark >> Contributors: Marianne Clark, Lisa McLean, Alicia Roberts, Kate Roberts, Heather Scott, Murray Tong >> Photography: Olivia Brown, Jimmy Chul-Ahn Jeong, Vince Filby, Andre Garneau, Martin Schwalbe >> Design and Layout: Jay Dart >> First Printing: November 2004