Research
UNIVERSITY of GUELPH
Focus on DHA

Mighty milk

New nutrient is a boost for human diets

Cows' milk, already a super source of so many good nutrients, is getting an added boost. Guelph researchers have discovered how to enrich milk with docosahexaenoic acid (DHA), an essential nutrient missing in many people's diets.

Prof. Brian McBride and graduate student Tom Wright, Department of Animal and Poultry Science, developed a special feed supplement for dairy herds and teamed up with Prof. Bruce Holub, Human Biology and Nutritional Sciences, to determine its effects on milk fat.

The milk these herds produce after eating the supplement will be DHA-enriched.

"This is a very practical discovery," says McBride. "This has the potential to significantly benefit human nutrition."

A favourable fat

Despite the emphasis on reducing dietary fat intake in Canada, our bodies do need some fat. In particular, DHA — an omega-3 polyunsaturated fatty acid (PUFA) — is needed in the eye and brain for optimal visual performance and mental functioning. DHA is important for development all through life, including as we age.

There is 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.

But food sources of DHA are limited. Fish and fish oils are the primary source. There is a small amount in eggs and some meats, but plant foods contain no DHA. Alpha-linolenic acid (LNA), another omega-3 PUFA, is found in some plant oils. The body can convert LNA to DHA only to a limited degree.

"The body can transform about four per cent of LNA to DHA," says Holub, "but there's evidence that babies have an even lower conversion rate."

And that's a concern because infants have high needs for DHA. Infants are in a stage of active learning, information processing and intellectual development, all of which require DHA.

Breast-fed babies are usually not at risk because human milk naturally contains DHA; the level will depend on the mother's diet. But this isn't the case for infants on North American commercial formulas that lack DHA, or for babies and young children on cows' milk.

Cows' milk contains zero to trace amounts of DHA. Cows get some fatty acids in their diet, but those they ingest are from plant sources, which don't include DHA.

Fatty acids in plants are often polyunsaturated. The bovine digestive system changes fatty acid structure from polyunsaturated to saturated through a process called biohydrogenation.

Because LNA undergoes biohydrogenation, there is limited opportunity for conversion of LNA to DHA. As a result, cows' milk is devoid of DHA.

Customized feed success

The customized feed developed by the researchers provides for the natural enrichment of DHA in cows' milk at levels that parallel those found in the milk of nursing mothers.

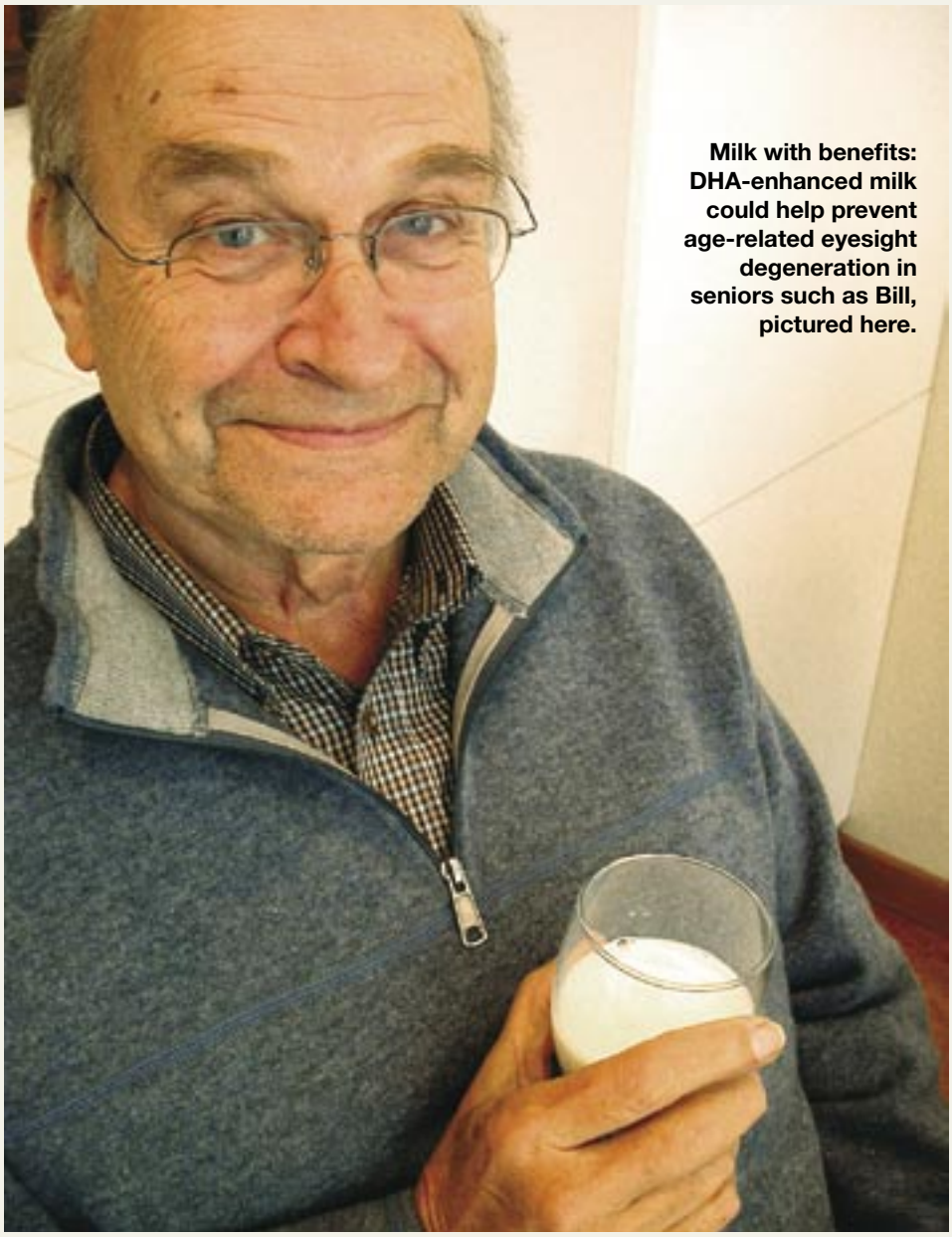
How does it work? Holub suggests that DHA in the feed is less susceptible to biohydrogenation than LNA and other PUFAs are. McBride and Wright also think that something about the formulation they've created inhibits biohydrogenation. That means LNA could pass through the gut unaltered and be converted in part to DHA. DHA — included in the feed supplement — remains unchanged as well.

This research was sponsored by the Natural Sciences and Engineering Research Council and the Ontario Ministry of Agriculture and Food.

INSIDE: Essential fatty acids pack a healthy punch

All eyes on Bossy's diet

Guelph's fortified milk process could mean better vision earlier and longer



Milk with benefits: DHA-enhanced milk could help prevent age-related eyesight degeneration in seniors such as Bill, pictured here.

We're all busy minding our heart health and waistlines to try to stave off old age, but we may be neglecting the very organs that will enable us to see our grandchildren: our eyes.

Owen Roberts

An alarming study came forward recently from the U.S. National Eye Institute, an arm of the federal National Institutes of Health, warning that the number of Americans with major eye diseases is soaring, and vision loss is becoming a major public health problem.

By the year 2020, the number of people who are blind or have impaired vision is expected to increase substantially. Blindness or low vision affects 3.3 million Americans 40 and over, or one in 28, but the U.S. study says this figure will climb to 5.5 million by 2020. Low vision and blindness increase significantly with age, particularly in people over 65. People 80 years of age and older currently make up eight per cent of the population but account for almost 70 per cent of blindness.

The big problem is something called age-related macular degeneration (AMD), the leading cause of vision loss in the developed world. AMD causes the macula (located in the centre of the retina) to deteriorate, resulting in a gradual or sudden loss of central vision. Your peripheral or side vision is less affected, but it's a small consolation.

One in four Canadians will have clinical signs of AMD by age 75, says the Canadian National Institute for the Blind (CNIB). More people are affected by AMD than glaucoma and cataracts combined. The institute says this condition has eluded the spotlight, possibly because it doesn't lead to total blindness, or because seniors simply accepted AMD as a natural part of aging.

But as decision-makers grow older and the general population greys, these kinds of conditions get a new profile. The CNIB and an organization called the AMD Alliance International (www.amdalliance.org) are profiling the matter, trying to help direct government funding for research and treatment.

And now, AMD has a farm connection, too. A new milk called Dairy-Oh! has arrived, containing a natural substance called DHA — an acronym for docosahexaenoic acid, one of the highly touted Omega-3 fatty acids — that's considered vital for the development and maintenance of the retina (as well as other organs and central nervous system). The National Eye Institute found that in 5,000 people 65 or older, DHA sparked nearly a 50-per-cent reduction in neovascular AMD, a form of AMD that causes increased or abnormal blood vessel growth within the retina.

We normally get DHA from eating fish — in fact, that's really the *only* way we get it. But health professionals say we get way too little of it, anywhere from a third less than we need to almost one-half.

With financial support from Dairy Farmers of Ontario, University of Guelph researchers have figured out a way to get DHA into milk. Their plan also involves fish — they mix DHA-rich East Coast Canadian herring meal with a cow's feed. The DHA is absorbed by the animal and secreted into the milk; those consuming the milk get easy access to DHA. And there's no fishy taste.

Dairy farmers like the natural approach. This is basically a fortified food, and fortified foods, such as breakfast cereals and bread have been around for ages, well accepted by consumers. Although Bossy the cow is an unusual source of this particular fortification, the end result — better vision longer — is expected to resonate with a major segment of the population.

Owen Roberts, director of research communications for the University of Guelph, writes a weekly column for the Guelph Mercury *newspaper. This column originally appeared in the* Guelph Mercury *April 20, 2004.*

Essential fatty acids pack a healthy punch for humans

Omega-3-rich foods are important for sight and smarts

With low-fat and no-fat foods dominating supermarket shelves and low-carbohydrate diets gaining mass appeal, it's easy to lose sight of what's needed for a healthy diet. In fact, healthy fats such as omega-3 fatty acids are often overlooked by consumers.

Omega-3 fatty acids are essential nutrients that provide a variety of health benefits from conception to old age. The three omega-3 fatty acids are ALA (linoleic acid), EPA (eicosapentaenoic acid) and DHA (docosahexaenoic acid).

Of these, DHA is the most important. DHA is crucial for the proper development of brain, nerve and eye tissue of unborn babies in the last three months of pregnancy and during the early months and years of a child's life. It is also essential throughout the lifespan for the ongoing maintenance of the brain, visual acuity and the nervous system.

Mounting evidence suggests that DHA may delay or prevent the onset of Alzheimer's disease, and larger intakes of DHA are linked to heart health in adults. That's why heart associations now advise people to eat fish two to three times a week, as fattier fish are the main source of DHA.

But nutrition researchers say many Canadians are lacking DHA. Among those most deficient in DHA are pregnant women and young children.

The best way to get enough DHA is to eat DHA-rich foods. These include fish such as salmon, halibut, cod, sole, herring, sardines and canned white tuna and sockeye salmon. Omega-3 eggs, flaxseed, flaxseed oil, canola oil and canola oil margarine are other good sources of DHA. To find out how to increase DHA intake, check out the chart below. Just two servings of fattier fish and one or two omega-3 eggs a week will average out to more than enough DHA to meet nutrition researchers' recommendations.

Food	DHA Content (milligrams)
3 ounces/90 grams cooked:	
Herring (kippered)	1,003
Halibut	318
Haddock	138
Mackerel (Pacific, jack)	1,016
Salmon	1,200
Rainbow trout	575
3 ounces/90 grams canned:	
Sockeye salmon	564
White tuna	535
One omega–3 egg	400

Fish such as rainbow trout and salmon, pictured here, are a good source of DHA, an omega-3 fatty acid important for brain development in infants and heart disease prevention in adults.

Omega-3s come to the table

The health benefits of so-called "oily fish" — such as farmed trout and salmon — are tough to sell to consumers who don't like its taste and smell. So researchers at the University of Guelph are taking a new approach. They're putting dried fish powder in an everyday product — bread.

Prof. Bill Bettger and graduate student Terry McKay, Human Biology and Nutritional Sciences, are studying what happens when microencapsulated fish oil is baked into loaves of bread. The researchers are using a household breadmaker to perfect the recipes of whole wheat and multi-grain varieties. They don't have final results yet, but they have found the taste of fish oil is undetectable.

They want to know if fish oil that's baked right into an everyday food like bread will be absorbed by the body in the same way that supplements are absorbed.

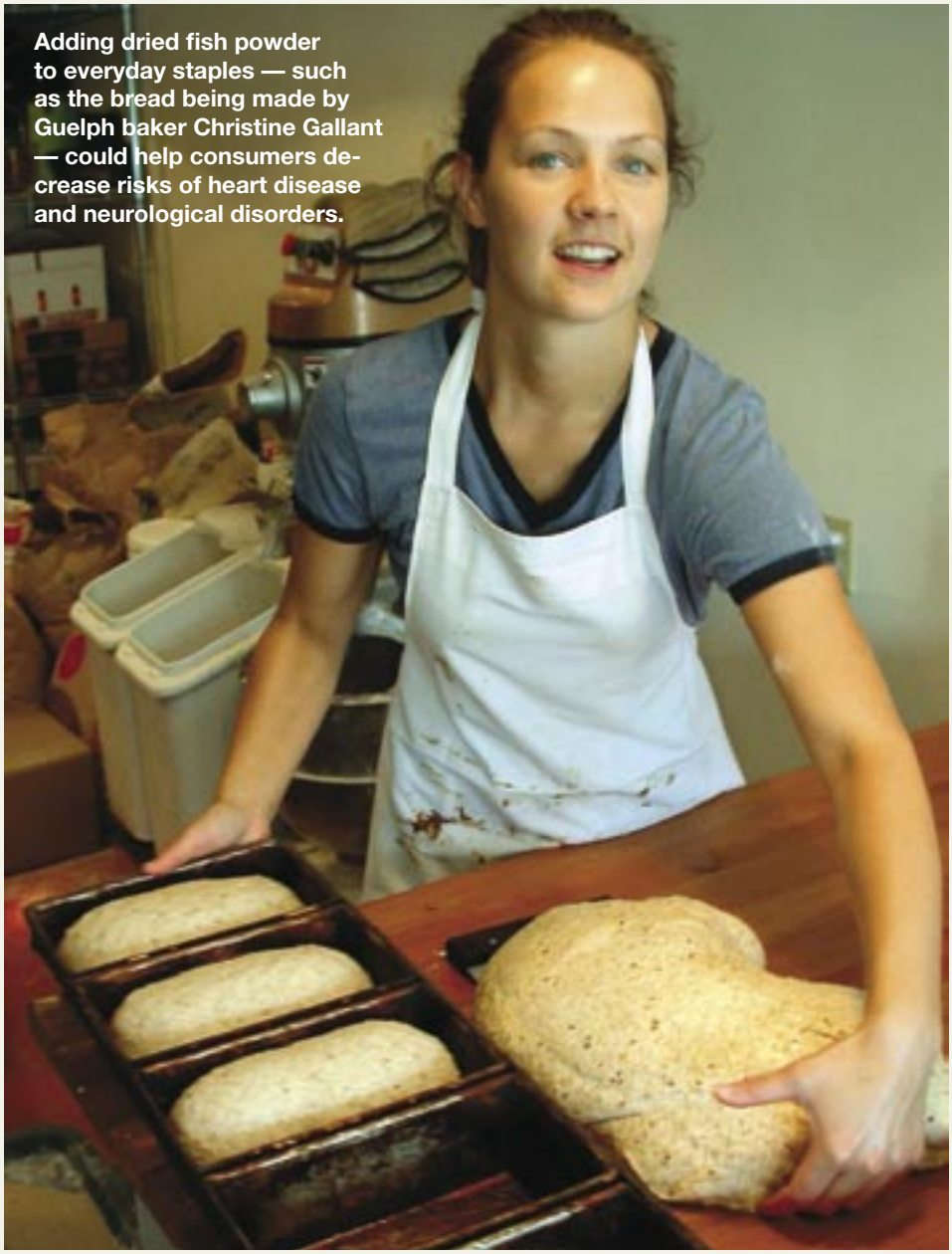
Health professionals have been advocating the nutritional benefits of oily fish consumption for years. It's an excellent source of omega-3 fatty acids, which are recognized by Health Canada as highly unsaturated "heart healthy" fats. Omega-3 fatty acids have been associated with decreased incidence of cardiovascular disease and mental disorders such as attention deficit disorder and Alzheimer's disease.

Omega-3 fatty acids are necessary for properly maintaining human and animal health. The body lacks the ability to make adequate amounts of some Omega-3s for chronic disease treatment and prevention, so they have to be ingested in food.

Docosahexaenoic acid (DHA), one of the most important omega-3 fatty acids, is a major component of brain and eye tissue. Fish — especially cold-water species such as salmon, trout, mackerel, halibut and tuna — is naturally rich in DHA and another omega-3 fatty acid called eicosapentaenoic acid (EPA), which also has anti-inflammatory properties.

Fish is rich in omega-3 fatty acids because cold-water fish eat other fish, algae and zooplankton, which are also extremely high in DHA. Consuming two to three servings of these types of fish per week will help consumers meet the suggested DHA dietary intake.

But some people just can't handle fish.



Adding dried fish powder to everyday staples — such as the bread being made by Guelph baker Christine Gallant — could help consumers decrease risks of heart disease and neurological disorders.

Other popular meats such as beef, pork, chicken and lamb are fed plant-based diets, and they are a poor source of DHA.

So the Guelph researchers are trying to find another way to get DHA into the food chain. During a three-week test period, a group of 14 participants will take fish oil supplements, while the other consumes the supplemented bread. After a three-week "wash out" period — when nothing is taken — the groups will switch, taking the opposite form of fish oil.

A fairly short observation is possible because it takes just three weeks for fish oil to begin lowering the body's triglyceride (a type of fat in blood that's associated with cardiovascular disease) count and increasing blood omega-3 fatty acid levels.

If this bread proves to be an effective source of omega-3 fatty acids, the researchers would like to see it hit the market.

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