Dairy Farmers of Canada (DFC) held its 12th annual rotating symposium in Vancouver, Toronto, Montreal and Moncton. In keeping with the tradition from previous years, DFC invited four experts to present the latest research in areas of current interest in food and nutrition.

The symposium attracted large and passionate audiences of health professionals with a stake in nutrition. Following the success of last year’s inaugural Webcast, people had the opportunity to attend the symposium—and ask questions—via the Web. Moderated by Sue Mah, MNSc, RD, in Vancouver and Toronto and Joane Routher, RD, in Montreal and Moncton, the symposium began with an introductory talk that reviewed prospective studies and meta-analyses refuting the myth that dairy products have a negative impact on cardiovascular health. The guest speakers covered such diverse topics as caloric restriction and longevity, the impact of the alkaline diet and dairy products on bone health, new thinking about lactose and gluten, and animal welfare as related to milk production and milk quality.

WELCOME TO CONTROVERSATIONS

Discussing Timely Food and Nutrition Issues

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THE FULL SYMPOSUM IS AVAILABLE IN WEBCAST AT www.dairynutrition.ca/symposium

This meeting coverage from Dairy Farmers of Canada Symposium is printed as a service to health professionals and is made possible through the financial support of Dairy Farmers of Canada.

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CALORIC RESTRICTION AND LONGEVITY

Variations in human lifespan have always intrigued people, and the quest to boost longevity has spawned a large body of research. The idea of restricting calories to extend life has been on record since the fifteenth century, when an Italian nobleman wrote “La Vida Sobra” (the sober life), a book about the art of living long. His message: eat what agrees with your digestion, and eat as little as possible.

The scientific study of caloric restriction (CR) began about 100 years ago, with early experiments on rodents showing highly promising results. More recently, meta-analyses have uncovered a linear relationship between the extent of restriction and the increase in rodent lifespan. Mice eating 60% fewer calories than normal can expect to squeeze 50% more years out of their lives. Experiments in nonhuman primates have also shown promise. Research published in Science in 2009 found that Rhesus monkeys whose caloric intake was restricted for 20 years, starting at age 10, had significantly lower age-related disease and mortality rates than controls.

In early rodent experiments, subjects typically began CR immediately after weaning. This led researchers to wonder: do the longevity benefits still persist if CR is started later in life? As it turns out, they do. All it takes is eight weeks of caloric restriction, even if initiated in old age, for rodents’ mortality curves to separate from those of matched controls. The caveat: they may need to have the right genes.

Studies of CR in various species have found the strategy to work for certain genetic strains, but to have the opposite effect—that is, shortening life—in others. Researchers have theorized that CR works by switching off an organism’s “reproductive investment” and diverting it to cellular protection. If this theory holds true, CR carries less promise for humans, who invest relatively small portions of their life energy in reproduction. In fact, human studies to date suggest that starting a realistic CR regimen (i.e., no more than 30% restriction) in mid-adulthood may extend life by a modest one to four years.

More to the point is how lifelong CR affects quality of life. Quite a lot, it turns out. Persistent side effects include low-level hunger, feeling cold, and loss of libido. Eating less also leads the human organism to move less. Even if a person makes a conscious decision to exercise, spontaneous non-exercise activity (such as fidgeting or walking up stairs at a fast clip) tends to drop significantly. For most of us, the prospect of spending the next several decades hungry, cold, lethargic and sexually apathetic doesn’t make a compelling case for CR as a route to longevity.

THE ALKALINE DIET AND THE CHINA STUDY: WHAT DOES SCIENCE TELL US ABOUT THE IMPACT OF DAIRY ON BONE HEALTH?

By John R. Speakman, DSc
Professor School of Biological Sciences
University of Aberdeen

Two very popular approaches to nutrition in widespread circulation do not hold up to scientific scrutiny. The Alkaline Diet rests on the premise that certain foods increase the acidity of blood and urine, which in turn leads to health problems, and that eating alkaline foods can prevent or reverse these problems. The China Study is a book marketed as “the most comprehensive study of nutrition ever conducted,” despite its reliance on nonhuman and observational studies to implicate the consumption of animal protein in disease.

The China Study and proponents of the Alkaline Diet promote beliefs about animal protein and dairy products that persist although they are not backed by scientific evidence:

• Dietary acid from dairy products is harmful to human health
• Protein and phosphate in dairy foods make them acid-producing foods
• Dairy products may be detrimental to bone health because countries with higher dairy consumption have a higher incidence of osteoporotic fractures.

Unfortunately, some publications in our peer-reviewed literature appear to support such beliefs but these too are contradicted by the evidence. Dr. Fenton reviewed three quotations about milk, acid, and health and discuss the evidence for these claims.

1) “The modern western type diet is deficient in fruits and vegetables and contains excessive animal products, generating the accumulation of non-metabolizable anions and (causing) metabolic acidosis.”

Dr. Fenton and her colleagues conducted a systematic review of 228 papers on the topic and found only two that reported changes in the pH levels of urine and blood. In one cross-over study, urine pH was 6.5 in subjects following a regular European diet and rose to 7.5 when they were switched to a so-called alkaline diet. In the other study, urinary pH increased from 5.8 at baseline to 7 in subjects on a controlled alkaline diet. However, neither study found any significant change in blood pH with an alkaline diet. Acid produced by the diet does not produce “metabolic acidosis”—it is simply excreted.

2) “Acid-yielding diets cause urinary calcium loss [and] accelerated skeletal calcium depletion.”

In a 2001 study, researchers gave women drinks of cola, water or milk with a controlled breakfast, then compared acid excretion in the three groups of women over the next five hours. Acid excretion markedly increased in those who drank cola, increased more modestly in those who drank water, and slightly decreased in those who drank milk (see Figure 1). Similarly, a study comparing a soy-protein to a milk-protein diet found virtually identical levels of acid excretion in both groups (see Figure 2). These results refute the claim that milk products are acid-producing.” Furthermore, a systematic review of acid excretion and calcium metabolism found no relationship between changes in net acid excretion (NAE) and changes in calcium balance. Even when there is an increase in NAE, there is no change in calcium balance.

3) “Osteoporotic bone fracture rates are highest in countries that consume the most dairy, calcium, and animal protein.”

This claim is an ecological fallacy, i.e., a “bias that may occur because an association observed between variables on an aggregate level does not necessarily represent the association that exists at an individual level.” Differences between cultures, including the quantity of milk consumption, physical labour, differing vitamin D status and genetics contribute to the variation. Furthermore, osteoporotic fracture rates do not differ much between urban environments in Asia and North America.

In conclusion, it is clear that the diets we consume are not “acid-producing”; that diets based on milk- and soy-proteins produce similar acid excretion; and that calcium balance is not affected by net acid excretion.

Conclusions on Caloric Restriction
• Animal studies suggest that starting caloric restriction in mid-life (aged 39+) at levels that are realistic in humans (15% to 30% restriction) will generate only modest longevity benefits of between one and four years life extension.
• The hunger of restriction does not appear to decrease over time (at least to the equivalent of eight years restriction) whether caloric restriction with appetite suppression will work is uncertain.
• While responses to caloric restriction appear superficially similar in animals and humans, the details may be very important. Whether the differences or the similarities are more important remains an unsolved question.
LACTOSE AND GLUTEN: IMPACT ON GUT MICROBIOTA AND HEALTH

Wendy J. Dahl, PhD, RD, FDC
Assistant Professor
Food Science and Human Nutrition
University of Florida

The gut microbiota evolved in step with human physiology. This symbiotic process has left the modern human gut teeming with bacterial cells: about 100 trillion in total, representing over 1,000 species of bacteria.

The microbiota:
• Helps digest dietary fibre, starch and other substances in the colon
• Helps produce short-chain fatty acids (such as butyrate) that protect against inflammation
• Assists with amino acid and vitamin K synthesis
• Helps metabolize bile acids, other sterols and xenobiotics
• Helps the body defend against pathogens.

The microbiota in the colon completes the digestive process by fermenting substances such as dietary fibre, oligosaccharides, fructose or lactose that are not digested in the stomach or small intestine. Carbohydrate fermentation produces short-chain fatty acids, especially butyrate which is the primary energy source for the cells lining the colon. When butyrate levels are reduced or absent, inflammation characteristic of ulcerative colitis can result.

Diet, contaminated food, stress, antibiotics and aging affect the balance of the microbiota. Altered composition of the microbiota (dysbiosis), e.g., an increase in pathogenic bacteria or a decrease in beneficial bacteria, may influence the development of ulcerative colitis, Crohn’s disease, irritable bowel syndrome, obesity, type 1 and type 2 diabetes and celiac disease.

MICROBIOTA AND CELIAC DISEASE
Although gluten consumption is implicated as the cause of celiac disease, other factors, including genetics, early feeding practices (breast milk versus formula and the duration of breastfeeding), infections, and alterations in the composition of intestinal microbiota also play a role.

Increased awareness of gluten intolerance and celiac disease has led many people to adopt a gluten-free diet, even though they may not have this condition. Gluten-free diets tend to be higher in sugar, lower in fibre due to reduced lactase activity. However, most (80%) of the fructans in the North American diet come from wheat, eliminating wheat removes the main source of these compounds as well as the major source of dietary fibre.

MICROBIOTA AND PREBIOTICS
Over the past several years, researchers have been trying to identify specific substances that will enhance beneficial colon bacteria. Called “prebiotics,” these compounds are oligosaccharides (short chains of sugars) that resist fermentation and encourage the growth of beneficial bacteria, especially bifidobacteria and lactobacilli, in the colon.

These non-digestible compounds occur naturally in breast milk, wheat, onions, beans, and legumes. Prebiotics, in the form of inulin, fructooligosaccharides and oligofructose, are being added to many foods. While these substances have been shown to promote the growth of bifidobacteria, evidence of their overall health benefits is still needed.

Prebiotics derived from milk include:
• Human milk oligosaccharides (HMO)
• Commercially produced galactooligosaccharides (GOS)
• Synthetic disaccharide lactulose, consisting of fructose and galactose

To investigate the potential health benefits of prebiotics, we conducted a controlled trial of GOS supplements given to 420 healthy undergraduate students for eight weeks. We hypothesized that GOS supplementation during periods of academic stress would reduce stress-induced GI symptoms as well as the symptoms of colds thanks to the proliferation of beneficial bacteria in the colon.

During the stressful exam period, these students experienced less abdominal pain, indigestion, diarrhea, and constipation than matched controls. They also had less intense cold symptoms and spent fewer days suffering from these symptoms than subjects in the control group.

MICROBIOTA AND LACTOSE
Worldwide, the majority (75%) of people do not digest the disaccharide lactose due to reduced lactase activity. However, most (80%) of the fructans in the North American diet come from wheat, eliminating wheat

LACTOSE MALDIGESTION CORRELATES POORLY WITH LACTOSE INTOLERANCE

Lactose maldigestion correlates poorly with demonstrated lactose intolerance due to lactase deficiency. People who experience symptoms of lactose intolerance—bloating, cramping, gas, loose stools or diarrhea—do not necessarily have lactase deficiency. Conversely, most people who do indeed have lactase deficiency do not experience those symptoms.

Researchers have tried to identify the differences between people with true lactase deficiency and those who have severe symptoms. The major difference seems to be in visceral sensitivity, i.e., the degree to which individuals perceive pain associated with digestive transit and gas production. There is some evidence to suggest that consumption of prebiotics may help to reduce that visceral sensitivity.

The case for lactose being a prebiotic can be made on two main points. First, as with other prebiotics, its fermentation supports bifidobacteria growth. Second, the symptoms of lactose intolerance are similar to those caused by high doses of all prebiotic oligosaccharides, including lactulose, fructooligosaccharides and GOS. While people may be tempted to exclude these fermentable oligosaccharides from the diet in order to reduce symptoms, the health outcomes and effects of such restrictive diets on the digestive and immune systems are unknown. Indeed, the U.S. National Institutes of Health Consensus Statement on lactose intolerance and health states: “Many individuals with real or perceived lactose intolerance avoid dairy and ingest inadequate amounts of calcium and vitamin D, which may predispose them to decreased bone accrual, osteoporosis, and other adverse health outcomes. In most cases, individuals do not need to eliminate dairy consumption.

CONCLUSIONS
Restrictive diets, such as a gluten-free diet, require supplementation with prebiotics and fibre to maintain digestive health. The long-term effects of such diets on the digestive and immune systems are unknown. The consumption of oligosaccharides and disaccharides, such as lactose, GOS and GOS, which are resistant to digestion, may have prebiotic effects that promote the growth of beneficial bifidobacteria. However, high doses of these fermentable compounds may result in gastrointestinal symptoms—which are not exclusive to lactose—so the dose and timing of prebiotics is important. Finally, more research is needed to explore the potential health benefits of lactose fermentation.

FIGURE 1
NIH Consensus Statement on Lactose Intolerance and Health

• Lactose intolerance is a real and important clinical syndrome, but its true prevalence is not known.
• The majority of people with lactose malabsorption do not have clinical lactose intolerance. Many individuals who think they are lactose intolerant are not lactose malabsorbers.
• Many individuals with real or perceived lactose intolerance avoid dairy and ingest inadequate amounts of calcium and vitamin D, which may predispose them to decreased bone accrual, osteoporosis, and other adverse health outcomes. In most cases, individuals do not need to eliminate dairy consumption.
• Evidence-based dietary approaches with and without dairy foods and supplementation strategies are needed to ensure appropriate consumption of calcium and other nutrients in lactose-intolerant individuals.
• Educational programs and behavioral approaches for individuals and their healthcare providers should be developed and validated to improve the nutrition and symptoms of individuals with lactose intolerance.

(See “Strategies” box below.)

STRATEGIES FOR THE MANAGEMENT OF LACTOSE INTOLERANCE

• Drink more milk, more often! Colonic adaption occurs—resulting in fewer symptoms
• Consume lactose with meals
• Eat smaller portions of lactose throughout the day
• Eat hard cheese—it’s lower in lactose
• Eat yogurt (easier to tolerate due to bacteria)
• Lactose-free milk and lactase tablets are available as options.

Made possible through the financial support of Dairy Farmers of Canada
Panel Discussion

**Dr. Bergeron:** In organic farming operations, all food fed to cows must be certified organic, meaning they contain no pesticides or chemical fertilizers. Canadian organic standards don’t prohibit the use of antibiotics, but the withdrawal period is twice as long and the number of permitted treatments capped. While I believe conventional milk is just as safe as organic milk, organic farming has some arguably gentler impact on the environment and may thus appeal to people who believe conventional milk to be just as healthy as organic milk, organic farming has some arguably gentler impact on the environment and may thus appeal to people who believe conventional milk to be just as healthy as organic milk.

**Antibiotics:** The antibiotics used to treat mastitis and other bacterial diseases have “withdrawal periods” that specify the number of days that must pass after the last antibiotic treatment before the milk or the animal can enter the food supply. Any milk collected from a cow given antibiotics must be discarded for a period of treatment and the withdrawal period.

**Chemicals:** Pesticides may be used to control weeds, insects and parasitoids, fertilizers may be used on crops and sanitizers are used on dairy equipment and facilities. Several precautionary measures are taken to limit the risk of contamination, including safe-storage practices, use of registered pesticides, and strictly controlled harvesting/ grafting intervals.

**Milk production** is highly regulated at both federal and provincial levels: samples are collected at farms every second day, milk is tested at the farm (odour, temperature) before being transported to the processing plant where it is tested for bacteria count, white blood cell count, presence of antibiotics and antiseptics, and water and sediment content. If antibiotics are found or if any other test is failed, the milk is discarded and the producer is traced and subjected to a very high financial penalty.

**The Canadian Quality Milk (CQM) program** approved by the Canadian Food Inspection Agency, requires farmers to create their own on-site safety protocols and standard operating procedures. The goal is to improve management practices, increase communication and maintain effective records. A validator periodically audits farms to confirm the producers have implemented the CQM best practices for milk safety. CQM rests on three critical control points:

1. **Milk handling practices:** e.g., every treatment in the diary must be recorded and the withdrawal period respected.
2. **Cooling and storage practices:** e.g., temperature must be monitored and alarms must sound if it rises, records must be kept.***
3. Animal shipping practices:** e.g., animals and antibiotic in their systems cannot be shipped to abattoirs, needles must be accounted for, and records must be kept.

The CQM program comprises eight Best Management Practices that dairy farmers must ensure are met (see Table 1). All eight are inspected when the validator visits the farm to conduct the audit.

**ANIMAL WELFARE**

Advocates of animal welfare seek to improve how humans use animals. At the farm level, animal welfare can be assessed by input measures (e.g., feed, bedding, staff training) and output measures (e.g., milk production, health, fertility). Although it is impractical to assess everything, certain measures of health and welfare, such as body condition, lameness and cleanliness as well as quality of feed and bedding, can be readily quantified and scored.

To address animal welfare, the Care Animal Management Program for the dairy industry has been developed. Building on the existing CQM Best Management Practices, input and output measures of animal welfare will be added to this assessment and animal farms will be held this year. The objective is to incorporate this program, along with an environmental sustainability component, into the existing Canadian Quality Milk On-Farm Food Safety Program. With all these measures and best practices in place, Canadians can be confident that milk produced in Canada is of the highest quality.

**Food Quality**

Dr. Speakman: Is caloric restriction good for people with medical conditions?

Dr. Speakman: It seems that caloric restriction lowers the risk of age-related diseases in healthy people, but we don’t know whether it can reverse a pre-existing diagnosis. It stands to reason that good nutrition, rather than restriction, would promote recovery and health in sick people.

I was wondering how colon cleaning—a popular intervention these days—might affect microbiota?

Dr. Dahl: Colon cleansing removes existing microbiota. As such, it may allow pathogenic organisms to take over. In my view, it sets people up for increased risk and is definitely not necessary in people with a healthy set of microbiota.

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**Panel Discussion**

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**Is it worthwhile purchasing organic milk products if money isn’t a barrier?**

**Dr. Bergeron:** In organic farming operations, all food fed to cows must be certified organic, meaning they contain no pesticides or chemical fertilizers. Canadian organic standards don’t prohibit the use of antibiotics, but the withdrawal period is twice as long and the number of permitted treatments capped. While I believe conventional milk is just as safe as organic milk, organic farming has an arguably gentler impact on the environment and may thus appeal to people concerned with sustainability.

When you restrict calories, you’re also restricting important nutrients. How might this affect health and longevity?

**Dr. Speakman:** In animal studies, we ensure the reduced-calorie regimens don’t skimp on nutrients. The same can be said for humans who voluntarily restrict their calories in hopes of extending their lives. They take care to optimize their micronutrients and generally take supplements.

When we take a prebiotic galactooligosaccharide (GOS) supplement, might we be tampering with our body’s natural ability to produce healthy bacteria?

**Dr. Dahl:** We still don’t know what the ideal gut microbiotic profile looks like, though we have reason to believe a higher bifidobacterial count is beneficial. There seems to be a ceiling on the action of GOS. If you have already enough bifidobacteria in your system, supplementation won’t increase the count. In general, cheese is rich in calcium but it is also acidic. Can the calcium content of cheese, for example Parmesan, compensate for its acidic effect?

**Dr. Fenton:** It would appear that sulphates and phosphates, such as those found in cheese, are acid-producing, and looked upon unfavourably. We have conducted randomized controlled studies and meta-analyses on the effect of phosphates. We believed that they increased urinary calcium excretion and were curious what effect this would have on calcium balance, given that phosphate is one of the most important skeletal minerals. We found that giving phosphate supplements improved calcium balance, which goes against the usual hypothesis. This leads us to think that the phosphate content of foods is not the only factor that needs to be taken into consideration when it comes to acid production. You’re right, though: Parmesan cheese contains an interesting amount of calcium. But I disagree with it being considered acid-producing, despite its phosphate content.

Can we use galactooligosaccharides for irritable bowel syndrome and diverticulitis?

**Dr. Dahl:** There is currently more evidence for using prebiotics, rather than prebiotics like GOS, for these disease states.

Is caloric restriction good for people with medical conditions?

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