Boasting natural CLA in dairy and beef

CLA Network researchers are tapping the unique benefits of the rumen as a virtual "CLA factory" to add health-boosting value to dairy and beef products.

Cattle may seem like simple animals on the outside, but the rumen environment they contain is a complex treasure-trove of unique biology.

In addition to acting as a powerful natural biodigester of plant material, researchers are learning the microbial environment of the rumen supports many valuable nutrients and processes.

One of the most exciting of these is the special ability of the rumen to act as a virtual factory for producing conjugated linoleic acid (CLA) – a potential wonder nutrient for human health. This type of good fat, produced naturally by ruminant animals, is showing considerable promise for benefits related to cancer, heart disease, obesity, diabetes, kidney disease and bone density.

"The more we learn about the ability of the rumen to produce natural CLA, the more good news there is for consumers and for dairy and beef industries," says Dr. Erasmus Okine, a ruminant nutritionist at the University of Alberta. "We know that rumen processes produce CLA that is transferred into dairy and beef products. We also know levels of this natural CLA can be increased substantially in these products through simple changes to common livestock production practices."

Okine, who is also Chair of the Department of Agricultural, Food and Nutritional Science, is one of many leading researchers aiming to identify and take advantage of CLA opportunities, as part of the CLA Network.

Founded in Canada, the CLA Network is a collaborative team from academia, industry and government, including representatives from many areas of expertise such as research, food industry, health and communications. Together, they are working to harvest expertise such as research, food industry, health and agricultural, Food and Nutritional Science, is one of many leading researchers aiming to identify and take advantage of CLA opportunities, as part of the CLA Network.

The unique potential of natural CLA to enhance dairy and beef products stems from the power of the rumen, which scientists increasingly recognize as one of the world's most distinct and largely untapped biological resources.

Though the rumen structure is relatively basic, it contains billions of bacteria and other microorganisms. These make the rumen the densest microbial community, and the best one at degrading plant fibre, known to exist.

In the case of CLA, the advantages of the rumen come in to play when the animal digests plant material to release linoleic acid, which is a beneficial fatty acid that facilitates a number of basic biological processes in humans. The microorganism activity in the rumen alters linoleic acid, which results in the creation of CLA as well as precursors of CLA.

The CLA that is created by this process has potential health facilitating properties above and beyond those of linoleic acid. In particular, the new conjugated form has the valuable additional abilities to displace unwanted types of fat and to act as an anti-carcinogen. These two abilities are what have given CLA its considerable human health potential.

The role of livestock production practices

On the livestock production front, researchers over the past decade have undertaken pioneering studies to examine the role of production practices in influencing CLA levels.

While more research is needed to pinpoint the health significance of differences in these levels, scientists have identified clear base levels and strong potential for increases through production practices. This bodes well for the future marketing of CLA in typical dairy and beef products and for the development of CLA-enriched versions of those products.

"As a CLA research network, we're in the early stages of exploring production strategies, but the indications we're seeing so far are very encouraging," says Dr. David Glimm, an animal biochemist at the University of Alberta. "We're confident of developing effective production strategies that will both support enhanced CLA levels and make sense economically for livestock producers."

Natural benefits

Synthetic forms of CLA have been developed for both commercial and research purposes. However many leading scientists believe the CLA found naturally in beef and dairy products may offer the best avenue for developing CLA health potential.

There are many different CLA isomers. However, two of these - CLA 9,11 and CLA 10,12 - have been linked to health benefits and studied extensively for biological function. These two CLA isomers are known to be present in beef and dairy products.

The CLA that is created by this process has potential for livestock dietary modifications for increasing CLA production, says Okine. "This is leading toward practical production strategies for increasing CLA content in dairy and beef products."

This progress is creating an opportunity to enhance consumer perceptions of the health value of these products, he says. It is also opening the door for market expansion into new CLA-enhanced branded products, and generating potential for increased production efficiencies.

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Also known to be present in beef and dairy products is vaccenic acid, which recent research has revealed as a precursor to CLA 9,11. This precursor can be converted into CLA once inside the human body.
CLA levels in dairy
Production-oriented CLA research is a relatively new area, but already scientists have made great strides to understand natural CLA levels and how they may be enhanced.

In dairy products derived from Canadian cows handled under conventional conditions, studies have determined the average concentration of CLA as a proportion of total milk fat is normally 0.5 percent to 2 percent.

“The specific level varies depending on the specific feeding system used and on other factors, such as the genetics of the cow,” says Glimm.

Various dairy products, including the broad range of milk products, cheese, yogurt, ice cream and other products, all contain CLA. The specific level of CLA is higher in products with higher levels of total milk fat.

“When lower fat milk is made, the fat is taken out and then added back to get a standardized amount of fat, such as 2 percent, 1 percent or skim,” explains Glimm. “In that process, an equivalent proportion of all fats is taken out, including CLA.”

Based on this knowledge, researchers are exploring the potential for altering the proportion of CLA relative to other fats the final product. “The idea is to find ways to further enhance milk’s health value for humans.”

Dairy products have also been confirmed to contain vaccenic acid – the CLA precursor, says Glimm. The content of vaccenic acid can be quite variable, but a rough estimate is 2 percent of the proportion of total milk fat.

Research exploring the potential to enhance CLA in dairy products is now a major focus, says Glimm. This work is in early stages, but has yielded promising results.

“Currently, it is generally considered reasonable to get about a two- to four-fold increase in CLA in milk fat through relatively simple dietary manipulation,” says Glimm. “More extreme feeding strategies have been reported to achieve up to a ten-fold increase. Those strategies are unlikely to be practical, but they illustrate the very high range of CLA increase that can be achieved.”

CLA levels in beef
Studies examining the effects of beef production practices on CLA levels have also generated encouraging findings.

In meat derived from Canadian beef cattle raised under conventional conditions, studies have determined the average concentration of CLA is about 27.5 mg/100g of beef.

“The amount of CLA depends upon the amount of fat in the muscle,” says Dr. Priya Mir, a ruminant nutritionist and physiologist at Agriculture and Agri-Food Canada in Lethbridge, Alta. “Cuts with higher fat will deliver higher CLA. Also, meat from breeds that have higher intramuscular fat or marbling fat will deliver higher levels of CLA.”

Vaccenic acid – the CLA precursor – has also been found at notable levels in conventional beef. Typically, vaccenic acid levels of 2.12 mg/g of total fat are found in general muscle and 2.61mg/g of total fat are found in skirt muscle.

Early research has unveiled substantial potential to increase the CLA content of beef through dietary management and through breed selection, says Mir. “Based on our research and that of our colleagues, indications are CLA can consistently be doubled with simple modifications to production practices. We have even observed a tripling.”

The enhanced levels of CLA have been achieved in research studies by providing growing animals oils or oil seeds high in linoleic acid as as part of their diets, she says. “A level we’ve found works well is to provide about six percent oil on a dry matter basis.”

Another key option for enhanced CLA is increasing grass and forage in cattle diets, says Mir. “Pastured animals are more likely to have high CLA content. The extent of increase is related to the youth of the grass. This is because younger forage has higher leaf content and leaves are the component that contains the highest levels of beneficial fats that can be converted into CLA.”

Groundwork toward branded products
For production-oriented CLA research related to both beef and dairy operations, the major long-term focus is to assist in the broader goal of getting products on the shelves with identified CLA levels, including enhanced CLA levels.

A key step will be to develop standards for these products in the regulatory environment. As a result, CLA research on the production front is now broadening to stronger emphasis on measurement techniques.

“Before we can see beef products on the shelf with enhanced CLA levels, it’s critical that we develop rapid CLA measurement techniques,” says Mir. “This will allow us to develop systems that guarantee the amount of CLA in the product.”

A range of other production-oriented CLA research is ongoing that may contribute to the fine-tuning of CLA deposition in dairy and beef products. For example, Canadian researchers are designing a new project to learn more about how providing CLA-boosting feed to younger animals may affect where CLA is concentrated in fat molecules. “There are distinct advantages in getting the CLA molecules to locate in the central section of the fat molecule, where indications are this is the best location for humans to digest the CLA,” says Mir.

Research also indicates that CLA impacts how fat is formed in milk and how fat is formed and deposited in beef. “As a result, by understanding and careful tweaking these effects, we may be able to optimize not only the level of CLA but also the total fat profile of these products.”

This has potential to generate greater consumer demand for these products and new market opportunities for CLA-enhanced branded products.

For more information on the CLA Network, visit www.CLANetwork.com or email: CLANetwork@gov.ab.ca.