

ADVANCES IN

BEEF RESEARCH



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Canada Alberta Beef Industry Development Fund

Results for
producers
from nearly **60** research projects
completed over
four years



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BEEF RESEARCH



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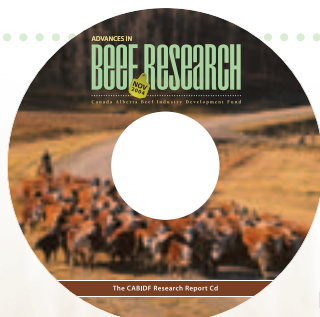
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Get more information on all projects

This magazine contains brief articles on nearly 60 projects funded in part by CABIDF. More information on each of these projects is available from two sources.

Research Reports on the Web. Longer reports that contain more detail on background, process and results for each project are available on the CABIDF Web site. Go to www.albertabeef.org/CABIDF and click on "Research Reports."

Full information on "The CABIDF Research Report CD." Alberta producers can also request one of a limited number of CDs that contain full information on each project. Each CD includes an electronic version of this magazine and all Research Reports from the CABIDF Web site, along with the bonus addition of Final Scientific Reports for many of the projects. The Final Scientific Reports, most ranging from 20 to 50 pages, are the actual technical reports researchers delivered to CABIDF upon completion of their projects.

To request "The CABIDF Research Report CD," contact the Alberta Beef Producers office at:

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Produced for the National Beef Science Seminar

*National
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Science
Seminar*

RESEARCH TO MOVE OUR INDUSTRY FORWARD

A message from CABIDF producer Chairman, Larry Helland



In the mid-90s, a number of Alberta beef industry leaders met to develop a research strategy to make use of the “bridging funds” resulting from the termination of the original Beef Industry Development Fund.

A decade later, that effort has produced an impressive legacy. The now complete Canada Alberta Beef Industry Development Fund has produced a significant and relevant body of research that will generate benefits for all sectors of the Alberta and Canadian beef industry for years to come.

The \$16.4 million program has invested in nearly 60 individual research projects in four key areas. Those included improving beef production efficiencies by tapping into Alberta’s natural production advantages; improving sustainable beef production, land and environmental management practices; improving the marketability of Alberta beef; and adding to the intellectual resources available to Alberta beef producers at educational institutions and research centres.

As we close the CABIDF chapter, we need to remember research is a long-term effort and we should be under no illusions that every project supported by the program will make a dynamic

difference in the production practices of every beef producer. Collectively, however, this work will move the industry forward and lead to new research projects.

A few key projects in particular deserve special mention.

One of our largest research projects, led by Dr. Ronald Read, which investigated the potential link between use of antibiotics in beef production and the emergence of antibiotic resistant bacteria, has provided important answers not only for the beef industry, but also for consumers.

As well, another million-dollar investment through Alberta’s Food Processing Development Centre in Leduc, has increased our understanding for improving beef quality and in developing new consumer products.

Alberta’s intellectual capital was increased significantly as the program brought world-class scientists, such as Dr. Stephen Moore, to live and work in our province. Moore, a renowned genomist, now with the University of Alberta, led ground-breaking research to identify genes that influence net feed efficiency. Working with the Genomics Canada project, he hopes ultimately to complete the genetic map of a beef animal. Another scientist brought in by the program was Dr. Doug Inglis, to work in ruminant enzymology at Agriculture and Agri-Food Canada in Lethbridge. Inglis’ work in that position has included progress to reduce *Campylobacter* and maximize feed efficiency. He’s also passed on valuable knowledge to students as an instructor at the University of Lethbridge.

Several other scientists from abroad have made their mark on Alberta’s beef industry with CABIDF support, under the visiting scientist program, which has brought in expertise in areas such as manure management, the ethics of animal welfare, food-borne pathogens and beef productivity.

While all sectors of the industry have been in survival mode since the BSE issue emerged in early 2003, the CABIDF research will enable us to improve productivity and profitability of the beef industry. The overall investment, shared jointly by the federal and provincial governments, will be returned many fold. Observers have said, for example, the research into phage therapy or bacteriophages, which are viruses that kill bacteria, in itself has potential to recoup the full cost of the entire research effort.

While it has been an honour to chair the board of directors, I emphasize that this has truly been a team effort. I wish to recognize the efforts of other voting board members over the years, including producers John Prentice of Calmar, Ed Thiessen of Strathmore, the late Neil Harvey of Cochrane, Weldon Thompson of Raymond, and Bob Nelson, a retired forage specialist with Alberta Agriculture, Food and Rural Development (AAFRD).

Also, I wish to acknowledge Dr. Steve Morgan Jones, past Director of the Lethbridge Research Centre and Dale Engstrom, who long-served as Manager of AAFRD’s Beef and Dairy Group, for their valuable input as non-voting advisors. I would also like to thank Don Milligan and Jackie Browne of AAFRD for handling research liaison for the Fund. And I would like to especially recognize Gary Sargent, then manager of Alberta Cattle Commission and later Alberta Beef Producers, and his staff, for their assistance and support over the years.

Over the scope of this program, which involved a review of 366 pre-proposals, the scrutiny of 111 full proposals and the final selection of the nearly 60 projects summarized here, a key objective has been to provide ongoing, effective communications to keep producers informed about project funding, project objectives and project results. This magazine completes that communications objective.

Larry Helland

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Message from the Minister of Agriculture and Agri-Food



On behalf of the Government of Canada, it gives me great pleasure to extend my appreciation for the outstanding scientific research that has been carried out through the assistance of the Canada Alberta Beef Industry Development Fund.

Agriculture and Agri-Food Canada has been a proud sponsor of the Canada Alberta Beef Industry Development Fund. The fund is a fine example of the excellent work that can be accomplished when federal and provincial governments and industry work in co-operation to ensure the long-term sustainability of the cattle industry.

By choosing to establish the Canada Alberta Beef Industry Development Fund, cattle producers in Alberta have shown great foresight. This fund has allowed cattle producers themselves to identify the research they believe is needed to improve the efficiency of their production and enhance the sustainability of their industry. In managing their own research projects, producers have been able to address issues that will ensure the long-term development of their industry.

Although it was developed as a regional initiative, the research carried out as a result of the Canada Alberta Beef Industry Development Fund has been of benefit to beef producers across the country.

Thanks to the valuable research that has been produced, Canadian cattle producers have been able to take advantage of many advances in areas such as disease resistance, beef health, and cow/calf production.

Governments in Canada are investing in the long-term strength of Canadian agriculture, and I continue to work in co-operation with provincial Ministers of Agriculture and with industry members. Together, we will ensure that Canadian cattle producers remain among the world's best.

Canada

Andy Mitchell
Minister

Message from the Deputy Premier and Minister of Alberta Agriculture, Food and Rural Development



Since May 2003, the Albertans who make up this province's beef industry have demonstrated their ingenuity, determination, and dedication to agriculture in more ways than I could possibly list. As Minister of Agriculture, Food and Rural Development, I have been inspired by the men and women who have overcome challenges by choosing to find opportunity. They have recognized that the sustainability of the industry rests on our ability to make changes for the better.

The Canada Alberta Beef Industry Development Fund is yet another example of Alberta producers choosing to invest in the sustainability of our beef industry. This \$16.4-million fund will help ensure the beef industry is a responsible contributor to Alberta's economy, environment, and rural landscape for generations to come.

The Government of Alberta has long recognized the importance of partnering with industry and academic organizations to further agricultural research. As Alberta's number one renewable resource, agriculture has much to offer Albertans. From bio-plastics to energy sources to improved food safety, the agricultural research done today will result in a better Alberta tomorrow.

Alberta

Shirley McClellan
Deputy Premier and Minister
Alberta Agriculture, Food and Rural Development

DNA vaccines to revolutionize disease protection

CABIDF PROJECT

1

Less cost, less hassle and better results.

This groundbreaking study investigated the potential for "DNA vaccines," which represent a revolution in vaccine technology, allowing for more efficient and effective protection against costly diseases.

Dr. Lorne Babiuk and colleagues developed DNA vaccine formulations for use against several bovine diseases, confirming advantages for inducing immunity in young animals, producing long-lasting immunity, opening the door for innovative delivery options and for use as combination vaccines against multiple targets.

"All of these factors should make DNA vaccines easy to incorporate into current management systems and reduce the costs of disease control," says Babiuk, Director of the University of Saskatchewan's Vaccine and Infectious Disease Organization (VIDO).

A major impediment to many vaccines is that they cannot be given to very young animals, since maternal antibodies interfere with the development of immunity. When young animals are vaccinated, often they are exposed to infection before they are vaccinated or before the vaccine can induce immunity.

Vaccinating calves at birth with vaccines that give life-long immunity would dramatically improve the economics of beef production, reduce animal suffering and reduce the use of antibiotics, he says. That is the promise DNA vaccines hold.

Researchers succeeded in developing formulations that contained protective antigens against specific strains of bovine herpes virus, bovine parainfluenza virus and *Haemophilus sommus*. They also confirmed these formulations performed well at self-generating antigens and were effective in inducing immune responses in neo-natal lambs, which are a good model for neo-natal cattle.

"Genes involved in inducing protective immunity can be incorporated into a cell in the animal, which acts as a mini factory to produce immunity-inducing proteins."

- Dr. Lorne Babiuk

Strategies to reduce *Giardia* and *Cryptosporidium*

CABIDF PROJECT

2

Protecting environmental pathways is key.

Researchers developed management techniques for *Giardia* and *Cryptosporidium* spp. that will help reduce infection and transfer rates in cattle, leading to a reduced possibility of environmental contamination and human infection.

"Both of these parasites have the ability to infect humans and cause disease," says Dr. Merle Olson, University of Calgary. "These parasites have been associated with human health and environmental concerns, and many of those concerns stem from how the parasites might be transferred from cattle to humans - as was seen in the *Cryptosporidium* outbreak in North Battleford, Sask., a few years ago. For that

reason, we were looking for ways to reduce the occurrence of these parasites."

The researchers found that a confined environment increases the transfer of both parasites, so giving cattle more room to roam can help reduce transfer rates and infection levels. They also found that fenbendazole (Safeguard) can be used on pasture to control *Giardia* infection. Also, composting can be used to kill both parasites and calving should be done on open pasture to reduce the likelihood of parasite transfer.

"Our research did little to indicate how much of a performance problem these parasites are for producers, but this does not mean a negative effect is not present," says Dr. Tim McAllister of the Agriculture and Agri-Food Canada Lethbridge Research Centre. "Some strains are more virulent and deadly to calves than others, but we don't know why. That's one of the many areas that needs continued research."



"Reducing infection rates in cattle will help reduce outbreaks in humans."

- Dr. Tim McAllister

New knowledge on antimicrobial resistance

CABIDF PROJECT
40

The most comprehensive study to date shows few links between cattle production and key antimicrobial resistance concerns.

A broad, benchmark study into the potential connection between cattle production and antimicrobial resistance in humans shows no major link for most key antimicrobial resistance concerns.

"The most significant resistance concerns that we went into the project looking for, turned out not to be an issue," says study leader Dr. Ronald Read of the University of Calgary.

"Vancomycin-resistant enterococci (VRE) and methicillin-resistant *Staphylococcus aureus* (MRSA), while of tremendous importance to human medicine, were not found in feedlot cattle," says Read. "While it has been speculated that VRE in humans in Europe arose from feeding subtherapeutic levels of avoparcin to livestock, this practice was never used in cattle in Canada, and there is no evidence that existing feedlot practices promote or select for either of these two resistant organisms. Furthermore, *Salmonella* with multiple forms of resistance, reported to be found in outbreak situations in food animals, were not found in any of the feedlot animals studied."

The multi-component study is the most comprehensive of its kind and was performed using the most sensitive methodology available. Read, a University of Calgary Faculty of Medicine associate professor with extensive experience in microbiology and infectious diseases, led a team of microbiologists and feedlot health specialists, including Dr. Douglas Morck, Dr. Kevin Laupland and Dr. Merle Olson of the University of Calgary, along with Dr. Tim McAllister, Dr. Doug Inglis and Dr. Jay Yanke of Agriculture and Agri-Food Canada's Lethbridge Research Centre.

Only one potential form of resistance of concern for human medicine was found – broad spectrum resistance to cephalosporins in some strains of *E. coli* with resistance to ampicillin. However, says Read, "ampicillin resistance itself is common among *E. coli* of both human and bovine origin, and the possibility of transmission of ampicillin resistance alone to humans is likely a moot point."

Growing concern in human medicine

Antimicrobial agents are the drugs, chemicals and other substances used in medicine to kill or slow the growth of microbes, particularly those that cause disease.

While these antimicrobial agents are valuable and powerful tools for health protection, they must be used carefully to avoid contributing to antimicrobial resistance, says Read.

"Antimicrobial resistance occurs when microbe populations change in ways that reduce or eliminate the effectiveness of the antimicrobial agents used against them," he explains. "When antimicrobial agents are over-used, this can contribute to the build-up of resistance, because it places added selection pressure on the microbe population to change in ways that allow it to survive an antimicrobial attack."

Because antimicrobial agents developed for medicinal use are relatively rare, taking steps to prevent antimicrobial resistance is of major importance to maintain their effectiveness. "Obviously, as more agents are rendered less effective due to increased populations of antimicrobial resistant microbes, humans and animals that depend on those agents to battle disease become more vulnerable. It's a very serious issue."

The CABIDF-supported antimicrobial resistance study was initiated several years ago, at a time when cases of resistance to antimicrobial agents used in human medicine were on the rise worldwide – a trend that continues today.

While the widespread use of antimicrobial agents in human medicine is widely viewed as the primary factor contributing to this problem, the use of these agents in livestock production has also been speculatively linked as a contributing factor, although supportive data is sparse.

To help determine the validity of this concern, the beef industry in Alberta, through CABIDF, funded an intensive study to provide more knowledge on whether the use of antimicrobial agents in cattle production is contributing to antimicrobial resistance.

"With all the speculation, the industry wanted some hard evidence on what the real story was," says Read.

Most comprehensive study to date

In the project, researchers sought to identify key microbial pathogens in beef cattle and evaluate the antimicrobial resistance of those organisms.

The project focused on microbial populations of direct relevance to both human and veterinary medicine, and did so in both actual feedlot settings, as well as in controlled conditions in experimental pens. Feedlot studies involved collecting clinical samples from feedlot calves upon arrival at the feedlot, during the feeding period and before processing. Experimental pen studies involved evaluating whether commonly-used antimicrobial agents are more or less prone to produce resistance in cattle, and investigating whether removing antimicrobials from diets before processing reduces any resistance found.

In an additional component to the feedlot study, researchers also examined feedlot workers as potential carriers of antimicrobial resistant organisms, to see if there was evidence of acquisition of resistant organisms related to working directly in a feedlot environment.

"Overall, we used gold standard scientific methodology to maximize the sensitivity of detection, and looked for microbes that were felt to be the most likely candidates to be problems," says Read.

Commercial feedlot cattle study

Feedlot studies were conducted at four commercial feedlots clustered around Calgary, but separated widely in space from each other. Animals were sampled from both nasal and rectal mucosa for specific organisms:

Nasal samples. Methicillin-resistant *Staphylococcus aureus* (MRSA), *Pasteurella multocida*, *Mannheimia haemolytica*, and *Haemophilus somnus* (now *Histophilus somni*).

Rectal samples. Vancomycin-resistant *Enterococcus faecium* and *Enterococcus faecalis* (VRE), all *Salmonella* species, thermophilic *Campylobacter* species, particularly those resistant to macrolides or quinolones, and *Escherichia coli* resistant to quinolones, aminoglycosides, or b-lactam antibiotics.

No significant concerns for key microbes

The results related to the major antimicrobial resistance concerns all showed no significant connection between antimicrobial use in cattle production and the development of resistant organisms. In the 7,738 samples taken:

- No MRSA were found.
- No VRE were found.
- Very few instances of resistance to tetracyclines and trimethoprim were found among veterinary pathogens, with one exception:
 - Tetracycline resistance was found in *Haemophilus somnus*. It was found in 0.5% of animals at entry, 14% at interim sampling, and dropped back down to 1% at exit. However, there was no association between this transient carriage of resistant *H. somnus* and preceding antimicrobial treatments.
- No resistant *Salmonella* species were found.
- Negligible and extremely low levels of resistance to ciprofloxacin, enrofloxacin, azithromycin, gentamicin and meropenem were found in *campylobacter* species.
- Resistance to tetracycline and doxycycline was seen in all three species of *campylobacter* detected.
- A moderate increase in resistance to erythromycin was observed in one *campylobacter* species, *C. coli*, but not in *C. fetus* or *C. jejuni*.
- No ciprofloxacin-resistant *E. coli* were found.
- Gentamicin-resistant *E. coli* were low (4%) at entry and midpoint samplings and rose slightly (7%) at the exit sampling.
- Ampicillin resistance in *E. coli* strains was found commonly
 - in 15% of animals at entry, 60% at interim sampling and 63% at exit from the feedlot.

“Ampicillin resistance has been well known in human *E. coli* for some time, and the possibility of additional strains being transmitted from an animal source may not be clinically relevant,” says Read.

Resistance related to ampicillin and cephalosporins found

- The one significant case of antimicrobial resistance of potential concern found was broad-spectrum cephalosporin resistance in several *E. coli* strains.

This resistance was mediated in most cases by an AmpC-type mechanism, and increased between entry and the midpoint of the study, then decreased somewhat prior to exit. AmpC is

a general category referring to genes encoding a b-lactamase enzyme with a broad spectrum, causing resistance to a wide range of penicillin and cephalosporin antibiotics. This resistance mechanism significantly limits the therapeutic options for treatment of these organisms when they cause infection. There are many varieties of AmpC genes, the most important of which are carried on plasmid DNA that can be passed between bacteria, thereby spreading the resistance pattern. An example of a plasmid-borne AmpC gene is CMY-2, an enzyme previously found in cephalosporin-resistant *Salmonella* strains of agricultural origin.

“The majority of our AmpC-mediated resistant *E. coli* strains carry the CMY-2 b-lactamase enzyme, which has been increasing in *Salmonella* and *E. coli* strains from food animals for several years, but is quite rare to be seen in humans,” says Read. “Virtually all strains of *E. coli* carrying the CMY-2 gene are also tetracycline resistant and many are florfenicol resistant, and it’s likely that in-feed or therapeutic tetracyclines, or therapeutic florfenicol exposure may act as a selective pressure on these organisms.”

Risk factors identified for AmpC-type resistance included use of florfenicol or oxytetracycline at entry to the feedlot. “While further study is needed, our data would imply that those antibiotics may be related to the persistence of this bug in cattle in the feedlot environment. As a precaution, it may be worth looking at ways to modify how those drugs are used, to reduce this problem.”

Surveillance is also warranted, he says. “Health Canada is currently establishing a surveillance system for antimicrobial resistant organisms in agriculture. We propose that these AmpC-type resistant *E. coli* strains be included in this monitoring program.”

Until there is further study, it’s difficult to speculate on how widespread AmpC-related resistance might be in the cattle industry, he says. “Results from this CABIDF study were based on samples from four feedlots around Calgary. We have to assume that results may be different at other feedlots in other areas, for example, at feedlots that use other antibiotic regimens in their operations.”

There is no evidence to show direct transmission of AmpC-type *E. coli* from cattle to humans, says Read. “For example, at our lab at the University of Calgary, we have not seen any of these organisms in feedlot personnel in our study. Overall, the rates of CMY-2 isolation from human isolates of *E. coli* in clinical laboratories are extremely low.”

Also, a recent, separate study led by Dr. Joyce Van Donkersgoed, a Lacombe, Alta, veterinarian who works on beef food safety, found a low incidence of ampicillin resistance (3%) and did not report any AmpC type resistance, among *E. coli* identified in HAACP isolates from carcasses at processing plants.

Commercial feedlot worker study

In the additional component of the commercial feedlot study, which evaluated feedlot workers for evidence of resistant organisms, no resistance was found.

continued on next page....

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- No MRSA, VRE, *Salmonella*, *campylobacter*, ciprofloxacin-resistant *E. coli* or CMY-2- producing strains were found in humans.

“Regarding the CMY-2 concern, our results suggest that either direct transmission to humans does not occur, or does so only rarely or transiently,” says Read.

Experimental small pen studies

Studies evaluating the spread of a naturally rifampin-resistant strain of *E. coli* showed that faecal-oral transmission was likely responsible for the observed movement of the organism between penmates. There was also no significant movement of this strain between pens and, in the absence

of antibiotic pressure, shedding of the organism occurred for only a short period after acquisition.

“These results suggest that widespread transfer of a resistant organism throughout a feedlot is not necessarily a foregone conclusion, particularly without any antibiotic selective pressure, and further suggests the possibility of strategies for containment of such an organism.”

Studies evaluating in-feed antibiotics at sub-therapeutic levels showed that Aureo S-700 was strongly associated with carriage of high levels of ampicillin (44%) and tetracycline-resistant (87%) *E. coli*, correlating closely in direction and magnitude with the observations in the commercial feedlot study, where Aureo S-700 was widely used in feed.

Protecting heifers from AIP

CABIDF PROJECT
3

New solutions for a deadly disease that affects the heaviest animals.

A-I-P: three simple letters that can mean big losses for cattle producers. Now, scientists have found ways to reduce those losses without a great deal of extra management.

Research shows feedlot operators can reduce heifer losses to atypical interstitial pneumonia (AIP) by not feeding melengestrol acetate (MGA), a commonly used estrus-suppression product. It also shows that acetylsalicylic acid (ASA) may increase the short-term life expectancy of cattle with AIP, and confirms that heifers are far more likely than steers to contract the disease, which damages lung tissue and is potentially fatal.

Over 900,000 animals were monitored for AIP and a variety of potential causal factors, making this study one of the broadest and most intensive conducted in bovine science, says Dr. Tim McAllister of the Agriculture and Agri-Food Canada Lethbridge Research Centre. “This is an important study because it identified potential control methods, confirmed that AIP affects mostly heifers, and took some major steps toward providing more knowledge of the disease, which will lead to further progress. This study has also spurred further research in the U.S., which is confirming and building on our findings.”

Finding a treatment for AIP is complex, because multiple pathways and predisposing factors appear to lead to the disease. “This is compounded by the fact AIP cannot be precisely replicated in an lab experiment, which forces us to conduct trials in real-world, commercial environments where the numerous variables that influence the disease cannot be controlled.”

Detecting sick animals

CABIDF PROJECT
4

New techniques could minimize treatment costs.

Two tests to detect specific blood proteins in cattle may give animal health personnel the objective tools they need to detect sick animals in the pen and

determine when antibiotic treatment is needed. For feedlot operators, that could lead to a reduction in the assumed need for antimicrobial treatment and significant treatment savings.

“Despite advances in the prevention and treatment of undifferentiated fever (UF) in feedlot cattle, it has not been possible to definitively determine which sick animals require antibiotic therapy and which animals do not,” says Dr. Kee Jim, a veterinarian from Feedlot Health Management Services in Okotoks, Alta. “However, if the case definition for sickness could be refined using objective tools, there would be considerable potential for reducing the number of feedlot animals receiving antimicrobial treatment for UF and a large drop – perhaps up to 50 percent – in overall feedlot therapeutic antimicrobial usage.”

Typically, to detect ‘sick’ animals, experienced animal health personnel – pencheckers – have had to rely on subjective parameters, such as general appearance and attitude, gauntness and reluctance to move. Jim and colleagues examined the potential of two new serum protein diagnostic tests, for enhancing the efficiency of sick animal detection in feedlot calves.

The results indicate that serum AGP and HAPT levels may be effective indicators of the need for treatment and could become useful tools for refining feedlot treatment protocols to reduce antimicrobial usage.

“The bottom line is that antimicrobial therapy may not be required for animals that are deemed ‘sick’ based on subjective clinical assessment by animal health personnel, but have low levels of AGP and/or HAPT,” says Jim. “Additional studies are required to investigate the usefulness of AGP and HAPT levels in ‘sick’ animals that do not have an elevated rectal temperature to refine the critical cut-off levels for each acute-phase protein, and to develop chute-side test kits.”

Improved testing method developed for Johne's Disease

CABIDF PROJECT

5

Culling is the only known control measure.

An eleventh-hour breakthrough in research has produced a much faster method for determining whether cattle might carry the bacteria that causes the economically significant Johne's Disease. Unfortunately, testing sensitivity was not improved and may reflect the reality of intermittent shedding of the bacteria during the early stages of the disease.

While a three-year project to develop an improved testing method showed promise, it appeared it might not be producing the desired results, says Ken Manninen. "However, a last minute advancement in molecular method technology was applied and produced the faster results that we had been hoping for.

"It's a significant improvement," he says. "Instead of the conventional culture method which took 10 to 20 weeks to get results, we can use this method and get test results in about two days," he adds.

The process that relies on immunomagnetic beads to detect the presence of the target bacteria, can help assure livestock producers of a disease-free status in animals they may be bringing into the herd, or can be used to determine if

Johne's Disease is the cause of any poor production performance in their existing herd.

Johne's Disease is a contagious, chronic, debilitating disease of ruminants that causes wasting, severe diarrhea and death. Although scientists had identified the bacteria that causes Johne's Disease at the time this research was launched, there was no timely and effective diagnostic test, says Manninen.

Countries throughout the world have taken a tough stance on screening for Johne's Disease. To remain competitive globally, Canada needs to provide evidence that cattle are free from the disease.

"This test is a significant improvement. Instead of the conventional culture method which took 10 to 20 weeks to get results, we can use this method and get test results in about two days."

- Ken Manninen



CABIDF PROJECT

6

SO₂ and cattle health

Exposure to sulphur dioxide can affect cattle health and increase winter feed requirements.

It's a high profile question that now has some answers. What is the impact of fossil fuel burning on nearby cattle?

A three-year investigation showed that exposure to sulphur dioxide (SO₂), can adversely affect the health of cattle and increase winter feed requirements.

Specifically, cattle exposed to SO₂ in a controlled environment showed measurable damage to their lungs and some suppression of the immune system, as well as an increased metabolic rate, particularly during cold weather, says Dr. Bob Christopherson, a specialist in animal physiology at the University of Alberta.

"The suppression observed in the cattle's immune system has potential to lower the animal's resistance to infection," says Christopherson. "I think we can also safely say that animals exposed to SO₂, as a result of their increased metabolic rate, have a higher feed requirement – perhaps 10 percent more feed would be a reasonable estimate."

While the study showed measured effects at all levels of exposure from 1 to 20 ppm (parts per million), further research is needed to determine the specific impact of these effects on animal health and production.

"It's a subject that has a lot of interest and a lot of emotion," says Christopherson. "At this stage, we felt there was a need to answer some of the basic questions."

Heat shock proteins indicate cattle stress

CABIDE PROJECT

7

Helps producers get jump on potential problems.

New research has pinpointed two 'heat shock' proteins (HSP) that could lead to an efficient detection of stress in cattle.

"While further research into the exact relationship between

"The ability to reliably determine when an animal is experiencing stress would be a significant step forward in reducing needless treatment with costly medication."

- Dr. Bob Christopherson

heat shock proteins and cattle stress is needed, we are confident that at least two such proteins can help distinguish cattle that are more or less responsive to particular

stressors," says Dr. Bob Christopherson of the University of Alberta.

Cattle are subject to stressful situations at all stages of production, including birth, weaning, transporting, entry into a feedlot and dietary change. Stressed cattle are vulnerable to illnesses, which can cause production problems for producers. Early identification of stressed cattle can help minimize losses.

The challenge for the cattle industry is to find efficient predictors of cattle stress that could compromise health. Christopherson says a number of physiological and behavioural methods are being used, but there has never been a good consensus on any method.

The major findings were that two heat shock proteins, HSP70 and HSP90, could be valuable indicators of stress, but individual cattle expression of proteins varied, making it hard to determine differences in stress susceptibility.

Decrease cattle stress – increase profitability

CABIDE PROJECT

30

Researchers test stress levels.

What are the true symptoms of stress in beef animals? How do they act? Those are the kinds of questions researchers tried to answer in a two-year study.

As a result, they made considerable progress toward an objective method of assessing the stressfulness of management practices used in beef production.

"Having the ability to objectively measure stress in cattle would allow producers to cut production costs and losses associated with stress by altering management practices to minimize its occurrence," says Dr. Gerry Mears, an Agriculture and Agri-Food Canada Lethbridge Research Centre scientist.

"In the study, we performed a series of experiments to evaluate the usefulness of several physiological and behavioural responses to stress as indicators of the relative stressfulness of various management practices," says Mears.

Building on previous studies conducted with sheep, researchers measured plasma cortisol, plasma beta endorphin, body temperature, heart rate and behaviour among cattle before, during and after routine management practices.

The results of this study, says Mears, have documented and clarified the physiological and behavioural responses to several management practices, which may allow a ranking of their severity.

"The project has allowed the recommendation of several behavioural and physiological measures that should be used in future assessment of stress responses in cattle."

- Dr. Gerry Mears

New BVD test more accurate, saves cost

CABIDF PROJECT
31

Works well on young calves.

A new and improved test for Bovine viral diarrhoea (BVD) was identified in this study, paving the way for major cost savings and simplified management for cattle producers.

Dr. Dirk Deregt and colleagues at the Canadian Food Inspection Agency's Animal Diseases Research Institute found that BVD tests based on a Polymerase Chain Reaction (PCR) method are very effective and can avoid the problem with the false positives that have been a challenge with conventional virus isolation (VI) tests.

"The results indicate that PCR assays can be used for screening calves for persistent infection with the BVD virus," says Deregt. "In comparison to

VI, the relative sensitivities of two PCR assays we evaluated were 100 percent."

BVD is a disease that can have devastating effects on herd health, sometimes causing abortions, infertility, congenital deformities, and the occurrence of persistently infected calves born to infected cows.

VI tests for BVD have long been available, but they haven't worked well for testing calves less than three

months of age – a key problem since the most convenient time for BVD testing for many producers is at branding. Specifically, the colostral antibodies a calf receives from its mother can distort the testing results and lead to false negatives. Infected animals that remain undetected can quickly spread the virus further into the herd through nasal secretions.

As the study confirmed, the benefits of PCR over VI tests are many. First, colostral antibodies do not interfere with PCR because the test focuses specifically on DNA derived from the virus. Tests can be performed after calving and – for animals testing positive the first time – again at branding. Since PCR tests are known to work well on frozen whole blood, samples taken at calving can also be stored frozen and later batch tested.

"Persistently infected animals can produce a lot of the BVD virus in their bodies, and they're constantly shedding that virus."

- Dr. Dirk Deregt

Improving immune response to vaccines

CABIDF PROJECT
32

Using interleukin-6 to enhance production of antibodies.

Scientists have tapped into the intricate communication network of the immune system looking for ways to enhance the efficiency of vaccines. Using a specific molecule called "interleukin -6," they focused on placing a strong line of defence right where viruses and bacteria launch their attack on an animal – at the mucosal surfaces of the respiratory and intestinal tracts.

Building on years of vaccination research conducted at the Vaccine and Infectious Disease Organization (VIDO) in Saskatoon, principal researcher Dr. Dale Godson led a team of scientists to test the efficiency of using interleukin-6 (IL-6) to improve the effectiveness of

vaccines. Interleukin-6 is known to increase the production of antibodies (molecules that can recognize and bind to viruses and bacteria).

Animals respond to traditional injected vaccines by making antibodies that circulate in the blood stream. That means an infection has to invade the animal's body before an immune response is produced. Interleukin-6 is unique in that it prompts cells to produce a type of antibody called immunoglobulin A (IgA), the antibody found most frequently at mucosal surfaces.

Since viruses or bacteria enter the body through the respiratory tract or intestine, that puts IgA in the first line of defence against infection. In this project, researchers added IL-6 to a vaccine to prompt an enhanced immune response at mucosal surfaces.



"The research could have several significant benefits for the beef industry. Most significantly, it could prevent disease from actually getting started."

- Dr. Dale Godson

Fighting bacteria the natural way

CABIDF PROJECT

39

Promising antibiotic alternative.

Bacteriophages – literally, “bacteria killers” – are natural, bacterium-specific viruses found in animal waste that invade and kill bacterium. Although largely ignored in the West after the discovery of antibiotics for treatment of bacterial infections, bacteriophages are now one of the latest antibiotic alternatives enlisted in the fight against diseases transmitted from cattle to humans.

“We have seen the emergence of new food-borne pathogens, such as *E. coli* O157:H7, that are difficult to control,” says Dr. Roger Johnson, a research scientist at Health Canada in Guelph, Ontario. “As well, we are encountering microorganisms that have rapidly developed resistance to many antibiotics. For example, *Salmonella Typhimurium* DT 104 is resistant to five or more classes of antibiotics. That’s why the scientific community is very interested in exploring avenues that could replace antibiotics under these circumstances.”

Johnson and colleagues examined the potential of applying bacteriophages to control *E. coli* O157:H7 and *Salmonella Typhimurium* DT 104 in cattle. The team identified several promising phages, which will be further studied and ultimately could be administered to large populations of animals, in feed, supplements or water.

“We have seen the emergence of new pathogenic bacteria that are difficult to control, and some have become resistant to multiple antibiotics. That’s why the scientific community is very interested in exploring new approaches to control these bacteria.”

- Dr. Roger Johnson

“The losses to the beef industry can be very substantial if meat products are found to be contaminated with pathogenic organisms, says Johnson. “This research will help keep Canadian beef competitive in the marketplace.”

Targeting an *E. coli* vaccine

CABIDF PROJECT

50

Scientists explore the potential of a promising antigen.

A study towards an *E. coli* vaccine has advanced the efforts for an affordable solution and increased public confidence in the safety of the beef industry.

“A key goal was to provide cattlemen with a choice of vaccine formulations, thereby introducing a competitive element into the supply system.”

- Dr. Glen Armstrong

The objective of the three-year study, headed by Dr. Glen Armstrong, a Medical Microbiology and Immunology professor while at the University of Alberta, was to prepare antibodies preventing *E. coli* surface structures from binding to the gastrointestinal wall

in cattle, ultimately allowing them to be flushed out of the system. However, the objective changed when, during the course of the study, researchers discovered that *E. coli* O157:H7 produces a 26 KDa antigen in infected cattle.

“A revised hypothesis was pursued because of its potential to ‘fast-track’ the development of a novel vaccine, which would be patentable over pre-existing formulations,” says Armstrong. “This could potentially provide cattlemen with a choice of vaccine formulations, thereby introducing a competitive element into the supply system.”

Initial research had shown that 26 KDa produces an immune response to *E. coli* O157:H7 infection. However, in the pilot study, when introduced as part of a vaccine formulation, this antigen did not produce a significant immune response.

Enzyme-generating barley

CABIDF PROJECT

11

Less cost and management than supplements.

Researchers identified strong potential for developing forage varieties that produce their own enzymes, which would boost feed efficiency with less cost and less management than using supplemental enzymes.

The promise lies in enzyme-producing genes found in rumen bacteria, which the researchers successfully introduced into the genetic material of barley.

Adding enzymes, such as glucanases and xylanases, to feed enhances the ability of cattle to digest cellulose and glucose in plant cell walls, says Dr. Surya Acharya, forage breeder at the Agriculture and Agri-Food Canada Lethbridge Research Centre. However, enzyme additives are often expensive and cannot be effectively used under extensive grazing conditions, reducing the incentive for producers to adopt the new technology.

"Introducing enzyme-producing genes into forages offers a safe and stable way to deliver the enzymes to cattle throughout their entire life cycle, even when in the pasture," says Acharya. "The first step is barley, but eventually we would like to see grasses have the enzymes as well. Even if we can achieve a small increase in feed efficiency by feeding enzyme-enhanced forages, we can make a major impact on the amount of feed required to produce meat."

"Full use of this technology will not only reduce the cost of beef production, it will also reduce the negative environmental impact of the industry through reduced manure production."

- Dr. Surya Acharya

Fall-seeded alfalfa struggles to get established

CABIDF PROJECT

12

System needs refinement before it can be recommended.

While the concept was good, attempts to direct-seed alfalfa into sod in the fall were thwarted by several common diseases, says Dr. Sheau-Fang Hwang, a plant pathologist at Alberta Research Council.

Research looking at the potential of the crop production practice, shows that several fungal pathogens take a large toll on seedling emergence and overwinter survival. In comparing different treatments, Hwang found

that, regardless of whether alfalfa was direct seeded into sod or into conventionally tilled soil the fall seeding treatment did not have the success and longevity of spring-seeded crops.

"Soil borne pathogens, such as *Fusarium*, *Pythium*, *Sclerotinia* spp. and *Rhizoctonia solani* can severely threaten seedling establishment and shorten stand longevity by causing crown and root rot," she explains. "These and other pathogens can attack feeder rootlets on healthy plants, reducing foliar productivity, and they can attack vulnerable seedlings and limit their establishment. Disease can also invade and kill plants weakened by environmental stresses and it becomes a major limiting factor in the production of alfalfa two or three years after establishment."

Management options which can help improve the survival odds of a fall-seeded stand include: using fungicide seed treatments to help prevent seedling blight and damping off, ensuring the crop has proper fertility, particularly sulphur and potassium, and potential

for using new alfalfa varieties that feature agronomic improvements.



Fall-seeded alfalfa did not establish as well as spring-seeded alfalfa, either in a sod-seeded or conventionally-tilled system. Establishment levels ranged from 40 to 60 percent of spring-seeded alfalfa.

"The practice of fall-seeded alfalfa has merit. But we feel more work is required to improve stand establishment."

- Dr. Sheau-Fang Hwang

Early calf weaning a new management option

CABIDF PROJECT
13

Approach applies best under extreme situations.

Very early weaning of calves, at roughly 2.5 months of age, may sound drastic, but a three-year research project led by Dr. Mick Price, a beef scientist with the University of Alberta, shows that under specific circumstances, it can make good economic sense.

Weaning calves early can take pressure off the cow herd. Even under poor growing conditions, for example, the female herd can regain body condition – improving herd health and reducing culling rates. Cows can go into winter in decent condition, perhaps reducing winter feeding costs. Although very early weaning does temporarily set back the calves, production losses can be recouped with decent pasture and/or a properly balanced backgrounding diet.

Observing about 240 head of spring-born cross-bred calves over the course of the study, Price and colleagues looked at calf and cow-herd performance with three weaning times. Calves were weaned very early, at 72 days or about 2.5 months of age, early, at 132 days or about 4.5 months of age, and, normal, at 192 days or 6.5 months of age.

By allowing the cows to go into winter in good to excellent body condition, a very early weaning strategy would save on expensive winter feed costs, particularly in a drought year. It would also help increase the pregnancy rates of poorly conditioned first and second calves.

“Many factors have to be considered when producers look at weaning date options,” says Price. Very early weaning of calves will increase cow body weights and body condition; however proper nutrition and management of the calf are important during this period.

“Understanding the costs of production of a cow/calf operation and how weaning age as a management tool shifts costs from one livestock enterprise to another is crucial, if weaning age is the approach taken to reduce cost of production.”

- Dr. Mick Price

New gene profiling technique

CABIDF PROJECT
14

Opens the door to predicting feed efficiency in young animals.

With the help of a new gene profiling technique, researchers are one step closer to an objective measure of future profitability in young animals.

The technique focuses on the genes that determine feed intake regulation, says Dr. David Glimm of the University of Alberta. “Not only has this research furthered the development of gene profiling techniques, it has led to the discovery of a collection of candidate genes with potential roles in regulating hunger and fullness in cattle.”

Glimm’s team used a revolutionary gene profiling technique called restriction fragment-differential display (RF-DD). “One of the primary reasons to work with RF-DD, in addition to its accuracy and reliability, is the fact that it allows high-throughput and can be performed on very small samples,” says Glimm.

Using their evaluation of differential gene expression in the GI tract of fasted and fed cattle, researchers discovered a group of candidate genes of potential

“This represents a valuable addition to the knowledge base and capability of beef researchers in Alberta.”

- Dr. David Glimm

economic importance to the beef industry. Several of those genes have now been isolated and sequenced, says Glimm. “Further characterization of the candidate genes in more cattle and relevant breeds can lead to the development of molecular genetic markers that allow selection of cattle for superior feed intake ability.”

Bred cows don't need supplemental protein in winter diets

CABIDF PROJECT
15

National recommendations overstated for Western Canada.

Pregnant and lactating beef cows don't require higher levels of protein than what has traditionally been recommended by livestock nutritionists, says Dr. Erasmus Okine, Alberta Agriculture, Food and Rural Development.

A recommendation, made in recent years by the National Research Council that pregnant cows – particularly in winter – require about 20 percent higher protein than has been conventionally fed is an overestimation for western Canadian

feeding conditions. “We found higher protein was just a waste of money,” says Okine, who studied more than 100 head of beef cows over three years.

The research project tested the theory held by nutritionists, that although energy requirements increase in cold weather, protein requirements do not increase, because there is reduced protein breakdown in the rumen.

“We suspected that, because of our colder temperatures, cattle are just more efficient when it comes to protein,” says Okine.

The revised 1996 NRC guidelines, based on research done mostly in the USA, recommended

that increasing protein requirements by 20 percent could improve livestock performance. That recommendation would mean increasing crude protein in a ration from about 11 to 12 percent to about 14.5 percent for pregnant and lactating beef cows.

Feeding trials done in Eastern Canada reported improvements in weaning weights and reduced overall production costs. But the Alberta research project bore out the theory about improved protein efficiency during cold weather. “We found that although the higher protein influenced rumen microbe activity, it did not reflect in significant improvements in performance,” says Okine. “Standard protein recommendations still apply.”

“We found higher protein was just a waste of money.”

- Dr. Erasmus Okine

Gene expression pinpoints top feed efficient cattle

CABIDF PROJECT
16

Wide variation between individual animals.

Changes in diet, environment and other factors will trigger different genetic responses in individual cattle, which may result in some animals that are more feed efficient than others, says Dr. Gordon Murdoch, a research associate in animal physiology.

Changes in gene expression in relation to whole animal metabolism, were among measurements noted in the project that looked for the genetic signposts that identify animals with superior energetics and feed efficiency.

Energetic efficiency refers to an animal's ability to use energy for both maintenance requirements and growth. An animal with better energetic efficiency will grow more under the same conditions and nutrient provision than an animal with poorer energetic efficiency.

“The research lays the foundation for developing a process to select animals with the genetic ability to be much more feed efficient,” says Murdoch. “If producers can select cattle with essentially equal optimized feed efficiency, it means instead of putting 100 head on pasture, they could perhaps graze 115 head that will all gain at the same rate, but with no additional input costs.” There would be more cattle on the same amount of grass, all achieving the same gains.

The research showed there are “greater individual variations among cattle in a herd than we previously thought,” says Murdoch. There may be some genetic differences between breeds, but the greater variation in this study was between individual animals. Again, using 100 head of cross-bred steers on pasture as an example, he found there may be 10 head in that herd may consume 125% as much grass as the other animals,

yet gain the same amount of weight. Those 10 are inefficient, he says.

The practical application is to develop a process to select young cattle or breeding stock with the superior energy and feed efficiency without selecting against other beneficial livestock attributes.

“The more we know about the process of growth and lean muscle deposition as it varies between animals, the more likely we are to select early for the most efficient and consistent producers.”

- Dr. Gordon Murdoch

New breeding strategy eliminates need for heat detection

CABIDF PROJECT
17

Based on synchronization of ovarian function.

A new ovarian synchronization strategy eliminates the need for heat detection and could make artificial insemination (AI) a more viable alternative for beef producers.

Dr. Reuben Mapletoft of the University of Saskatchewan's Western College of Veterinary Medicine and collaborators took the traditional concept of estrus synchronization a step further by managing ovarian function and the timing of ovulation in cows with a combination of hormone injections.

"What we did was take complete control of follicular development and ovulation so that we could breed the cow according to our timetable, not according to hers," Mapletoft explains. "With the schemes we used, we were not heat detecting at all and we were breeding at a planned, specific time."

The research showed higher pregnancy rates using the timed breeding approach and AI, compared to using traditional heat detection and

"The results of our studies will make genetic improvement more feasible through the use of AI."

- Dr. Reuben Mapletoft

and at the same time, simplify and reduce direct costs and cattle handling. That's what we achieved."

The results will help improve the success of AI programs, he says. AI is not currently widely used by beef producers, but Mapletoft believes that's partly because of the necessity for heat detection, misconceptions about the cost of AI and lack of consensus on desirable genetic traits. Although natural service is seen as a less expensive option compared to AI, overhead and maintenance costs of keeping the bull can translate into \$50 to \$75 per pregnancy, he notes, adding that \$50 will buy a good quantity of semen from genetically improved beef sires.

AI. "The overall objective of this project was to permit timed inseminations with high pregnancy rates

New options extend grazing

CABIDF PROJECT
33

Each extra grazing day cuts feed costs by up to \$0.50 per head.

Beef producers know each extra day they can keep cattle on grass is a small victory for the bottom line that can quickly add up to big savings. In this study, researchers identified a range of promising new forage lines to help generate those savings.

"It's a matter of simple math – if producers can graze their animals on pasture earlier in spring and later in the fall, they don't have to come up with as much conserved feed in the winter."

- Dr. Bruce Coulman

"The lines we identified feature improvements in one or more of spring growth, fall growth, yield and quality," says Dr. Bruce Coulman of the Agriculture and Agri-Food Canada Saskatoon Research Centre. "All are experimental seed lines that will now be increased and placed in the Western Forage Testing System. When available, they will reduce feed costs and improve the overall economics of production."

The researchers investigated several forage types, each with specific advantages.

Meadow brome grass. More productive in the fall than most other perennial grasses and stays green longer than smooth brome grass. Research shows enough variation in the species for significantly later fall growth.

Annual ryegrass. Both Westerwold and Italian ryegrass stays green and continues growth until the end of October, and provides nutritious pasture into December.

Crested wheatgrass. One of the earliest developing perennial grasses in the spring, has shown good adaptation to Alberta conditions.

Orchardgrass. Known for fast regrowth after grazing. Lines with improved winter-hardiness would be more suitable for Alberta.

Canada's first "PC rye"

CABIDE PROJECT
34

Beats barley as silage and offers lower feed costs and good persistence.

Perennial cereal rye, known as "PC rye," is a new forage crop for Canada that provides a valuable and practical alternative to annual silage and forage crops, says breeder Dr. Surya Acharya of the Agriculture and Agri-Food Canada Lethbridge Research Centre.

A hybrid forage that grows like a cereal, PC rye also has the longevity of perennial grass. Seeded in fall, around the same time as winter wheat, the crop can provide silage, hay and grazing opportunities for livestock producers over the next three to four years without reseeding.

"Ultimately, our goal is to generate a PC rye cultivar that can grow with forage legumes to produce high quality pasture and hay for our large cattle industry."

- Dr. Surya Acharya

"It's a perennial cereal crop that reduces seeding costs and has potential to extend the grazing season," says Acharya.

Seed for the first variety, ACE-1 is available in 2004. With winter hardiness also similar to winter wheat, it has potential to do well across a wide area of the Prairies, he says.

The key features of PC rye include its longevity over three to four growing seasons, its ability to produce a second crop or second cut for silage or grazing each year, rapid spring growth, as well as excellent feed characteristics as either silage, hay or pasture.

One important limitation to the crop is not to let it go to seed or allow it to get too mature, says Acharya. The crop has a tendency for floret sterility, due to its origin as an interspecific cross. The floret sterility results in reduced seed set and affected seed heads are susceptible to ergot infection, a fungal disease that is toxic to livestock.

Pinpointing triticale benefits

CABIDE PROJECT
47

Crop shows strength as alternative to barley for silage.

New triticale cultivars offer Alberta producers a viable alternative to barley for use as silage. Cultivars of triticale bred within the last 10 years are superior to older cultivars and have significant improvements in yield and ensiling characteristics.

Historically, triticale was grown on many western farms, but its popularity waned when negative agronomic qualities appeared. Researchers pursued the improvement of triticale because, despite its negative qualities, it had a lot to offer.

"Triticale has many positive qualities that drew scientists to take a second look at it," says ruminant nutritionist Dr. Karen Beauchemin, of Agriculture and Agri-Food Canada's Lethbridge Research Centre. "Producers need more information based on accurate research so they can understand how to maximize its value."

Beauchemin and her team discovered triticale's optimal cutting time – allowing producers to maximize production



"This new information supports the production of triticale as a silage crop."

- Dr. Karen Beauchemin

and ensure the highest feed value. Scientists were also pleased to discover new information about the effect of geographic location, fertilizer application, stage of maturity on forage quality and the differences between varieties.

New tools for riparian health

CABIDF PROJECT
53

Helping cattle producers protect this precious grazing resource.

Riparian areas have wide-reaching benefits for the environment, water quality, cattle grazing, fish and wildlife as well as a host of other uses and values.

In this study, a research partnership has developed two important tools to help sustain the health of these valuable areas. The first, a classification system, provides a knowledge basis for evaluating riparian areas. The second, a health assessment tool, provides cattle producers and others with a practical field workbook to determine, maintain and improve the health of riparian areas.

“Developing new knowledge, learning and working together leads to better socio-economic decisions,” says co-lead

researcher Gerry Ehlert of Alberta Sustainable Resource Development. “We are building a common knowledge and language about the importance of riparian areas, and how to measure key ecological functions.”

In this project, the research partnership focused on collecting new knowledge and developing tools for riparian areas associated with wetlands, sloughs and lakes found in northern Alberta.

The Riparian Health Assessment Field Workbook provides new insight and asks the user a series of questions that relate to the riparian area’s ability to perform key ecological functions (e.g., store water and sediment, build and maintain banks and shore, recharge aquifers, filter pollutants, reduce and dissipate energy, maintain biodiversity, and create primary productivity). The answers are compiled into a total score that informs the user of the area’s health.

“For a livestock producer, a healthy score indicates that grazing management and use is in balance with the ability of the riparian area to perform key ecological functions and that’s a good thing for everybody,” says Ehlert.

“For a livestock producer, a healthy score indicates that grazing management and use are in balance with the ability of the riparian area to perform key ecological functions and that’s a good thing for everybody.”

- Gerry Ehlert

FEEDLOT

Feedlot Projects include #s 9,10,18,19,20,21,22,35,36,56 & 59. For more information on each project, go to the Web site at www.albertabeef.org/cabidf

Swath grazing strategies slash costs

CABIDF PROJECT
9

Up to 50 percent savings.

Swath grazing can cut winter feeding costs dramatically, reduce labour requirements and enable producers to manage perennial grassland sustainably and more profitably.

“The bottom line is that in grain-growing areas where moose, elk, deer and ducks are not a management concern, swath grazing can greatly reduce winter feeding costs, in some cases as much as 50 percent,” says Duane McCartney of the Agriculture and Agri-Food Canada Lacombe Research Centre.

The three-year project examined the relationship between swath grazing and early weaning, yield and quality issues, time of seeding and cutting, as well as economic comparisons between swath grazing and other winter-feeding regimes. It was designed to answer questions raised by 125 producers

who had been surveyed in 1998 about their swath-grazing management programs.

The researchers concluded that feeding-ground management is the key to the cost effectiveness of swath grazing, says McCartney. “The most important management objective is to ensure cows clean up the swaths they’re grazing before giving them access to more. We strongly recommend the use of electric fencing to limit access to the swaths.

“If you’re grazing a quarter section, and cows have access to the entire field, the danger is that they’ll clean off the heads, then have nothing but the straw to eat for the rest of the winter. They need a balanced ration.”

Genetic link ramps up feed efficiency

CABIDF PROJECT
10

Research will lead to reliable EPD rating for moderately inheritable trait.

Researchers are several steps closer to developing reliable Expected Progeny Differences (EPD) to serve as a guide in selecting breeding stock with improved genetic potential for net feed efficiency, says Dr. Denny Crews, a beef genetics researcher with the Agriculture and Agri-Food Canada Lethbridge Research Centre.

"We know from EPD trends across the industry that mature size and growth rate have been on a linear increase. Cattle are getting bigger on average."

- Dr. Denny Crews

Data were collected by analyzing individual feeding data from nearly 500 head of Charolais-sired crossbred steers and results showed there is a predictable genetic link to improved feed efficiency, says Crews.

The method will lead to reliable EPD as the data base builds after more feeder cattle are analyzed in the coming years. Some very rough EPD may be available on a select trial basis in early 2005.

The work by Crews and colleagues refined the traditional concept of feed efficiency. The feed-to-gain ratio has traditionally been regarded as a measure of feed efficiency. But in practical terms, it is only a very broad measure of feed efficiency and does not produce predictable results with selection, says Crews. Research in the past three years has looked at genetic differences among cattle in terms of feed utilization.

"Rather than talk about feed-to-gain ratio, a more accurate term is residual feed intake (RFI) also referred to as net feed efficiency or residual feed efficiency," he says. "If you look at the overall energy consumed by a beef animal, we have divided that into energy portions, identifying amounts needed for maintenance and growth of the animal, as well as a residual (RFI) portion."

Residual feed intake can be used to select cattle that are more feed efficient without affecting body size and growth rate, or adversely affecting meat characteristics like marbling and grade, says Crews.

Surprising savings from winter night feeding

CABIDF PROJECT
18

Rate-of-gain, finishing time and feed efficiency improvements.

Feeding in the dark on a cold winter's night probably doesn't appeal to most feedlot operators. But, a new indication that night feeding can improve daily rate-of-gain by as much as 10 or 20 percent dangles a real economic carrot, says Dr. Alma Kennedy, a University of Manitoba researcher.

A two-year study involving about 500 head of feeder cattle in Alberta and Manitoba, looked at whether the time of feeding during the winter could improve weight gain and

feed efficiency in cattle. Feeding cattle at night, as opposed to standard daytime feeding, appears to have potential to improve feeder cattle performance, says Kennedy.

"Our research showed some cattle fed at night did have improved daily gains and improved feed efficiency over cattle fed in the daytime," says Kennedy. Cattle responses ranged from little or no response, to rate-of-gain increases ranging from nine to 28 percent,

finishing time reductions of up to 12 days and feed efficiency improvements by up to six percent.

"With this project, we achieved a proof of concept that winter night feeding can produce a positive response in cattle," says Kennedy. "Further study with larger groups of animals will be needed to determine precise benefits and how to produce consistent results, but it's clear that winter night feeding has some real potential."



"Cattle fed at night may be less aggressive than those fed in the daytime, so that would influence how much they eat and rate of gain."

- Dr. Alma Kennedy

“Rumen escape vehicle” to boost feed efficiency

CABIDF PROJECT

19

Yeast-based carrier delivers key nutrients to small intestine.

Researchers have developed a “rumen escape vehicle” that shows good potential to deliver beneficial proteins, enzymes and bioactive peptides to the small intestine of ruminants, therefore increasing feed efficiency and reducing manure volume.

The vehicle is a yeast-based cellular cloak that shields these valuable proteins as they travel through the rumen, says Dr. Brent Selinger, of the University of Lethbridge. This protects them from microflora such as bacteria, protozoa and fungi, which often digest a portion of the proteins before they become available for use in the small intestine.

“The protective system showed good results in a model rumen system in the laboratory,” says Selinger. “Based on this research, we can now look at producing some suitable methods and candidate proteins and move to testing in animal systems.”

Prior to this research, scientists had success using the rumen bypass method to promote more effective utilization of ration nutrients. However, no technique was available to transport biologically active proteins.

Researchers tracked the yeast, *P. pastoris*, through ruminal models using green fluorescent protein from jellyfish. “We found that the yeast, although it was slightly susceptible to degradation in the rumen, by and large appeared to get enough cells through the rumen,” says Selinger. Upon leaving the rumen, the yeast cell breaks open and releases the protein directly into the small intestine.

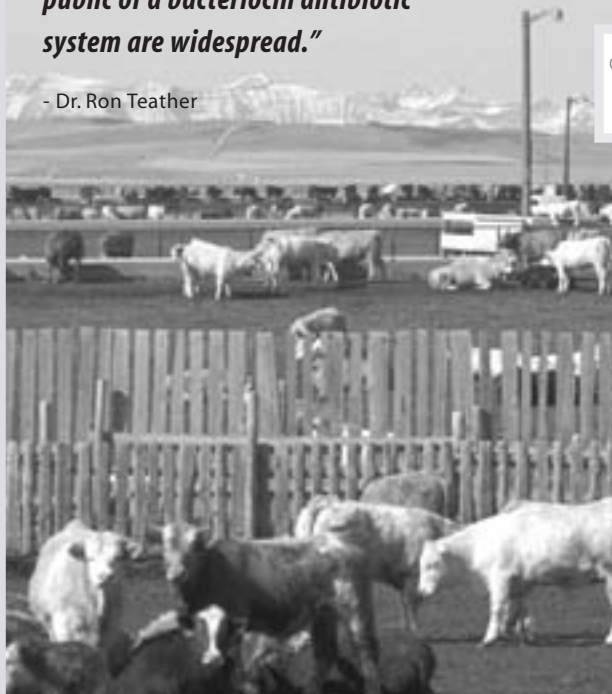
“For now, there are still hurdles to cross, but the promise is encouraging. As one next step, we’d like to test a number of bioactive proteins, to get a better idea of which ones would be best suited for use in this system.” Eventually, the benefits are most likely to become commercially available to producers as a feed additive.

“Based on this research, we can now look at producing some suitable methods and candidate proteins and move to testing in animal systems.”

- Dr. Brent Selinger

“The benefits to producers and the public of a bacteriocin antibiotic system are widespread.”

- Dr. Ron Teather



Bacteriocins offer multi-benefits

CABIDF PROJECT

20

Promising alternative to ionophore antibiotics.

Bacteriocins are tiny proteins that could improve feed efficiency, cut down on manure and methane output and alter the fat composition of beef and milk products.

Occurring naturally in the rumen, bacteriocins can inhibit the growth of specific rumen organisms, says Dr. Ron Teather of the Agriculture and Agri-Food Canada Lethbridge Research Centre. Scientists identified several promising bacteriocins that could be used in much the same way as ionophore antibiotics such as monensin, to produce efficiency benefits, as well as to control lactic acidosis, bloat, and potentially, pathogens such as *coccidia*.

Bacteriocins are also antibiotics, but unlike monensin, they’re proteins rather than small molecules, and they are produced naturally in the rumen of cattle. They function like antibiotics in that they target specific bacterial strains – bacteria produce them to eliminate other bacteria competing for the same food sources.

“Because they’re proteins, they leave no residue,” Teather says. “If you eat a bacteriocin, as soon as it gets into the digestive system, it is digested.”

Key step toward new growth promoter

CABIDF PROJECT
21

Has promise to reduce intestinal infection, boost feed efficiency.

Researchers succeeded in cloning the DNA sequence encoding bovine epidermal growth factor (EGF), a protein with potential as a feed additive to reduce intestinal infection and improve feed efficiency.

“Bovine EGF is a naturally occurring protein with excellent potential to improve feed efficiency and reduce intestinal infection in cattle,” says Dr. Sylvie Bilodeau-Goeseels of Agriculture and Agri-Food Canada’s Lethbridge Research Centre. “By cloning its DNA sequence, we have laid the groundwork for developing this protein as a feed additive for the beef industry.”

EGF is a peptide or small protein composed of 53 amino acids. It is a potent stimulant of proliferation for a variety of cell types including intestinal epithelial cells. Experiments in rodents also suggest a role for EGF in the regulation of nutrient uptake by intestinal cells. For

example, EGF has been shown to increase the transport of electrolytes, glucose and proline across intestinal membranes.

Epidermal growth factor also has some potential as a prevention/treatment agent for intestinal infections. In previous studies, oral EGF administration reduced the rate of intestinal infections in rabbits

“Reducing the rate of infection – and the resulting deaths – would be a significant saving for producers.”

- Dr. Sylvie Bilodeau-Goeseels

and prevented the reduction in weight gain caused by infection.

In Alberta cow/calf operations, approximately 0.4 percent of animals are lost each year to intestinal disease. During major outbreaks, the percentage can rise to a high of two percent.

“Reducing the rate of infection – and the resulting deaths – would be a significant saving for producers,” says Bilodeau-Goeseels.

Tweaking protozoa for performance, consumer health

CABIDF PROJECT
22

Additives that reduce specific rumen protozoa can boost cattle performance and enhance the human health benefits of beef.

Researchers know even small gains in feed efficiency and average daily gain can mean big benefits for Alberta beef cattle producers. This three-year study looked for ways to improve feed efficiency by reducing the population of protozoa within the rumen of beef cattle.

Using sunflower oil and other compounds as feed additives, scientists were able to decrease the number of detrimental protozoa within the rumen, which can significantly increase cattle performance and enhance carcass quality, says Dr. Tim McAllister of the Agriculture and Agri-Food Canada Lethbridge Research Centre.

“We found that long-chain unsaturated fatty acids, in particular linoleic acid, had a distinct inhibitory effect on protozoa without negatively affecting ruminal fermentation or bacterial activities,” says McAllister. “When applied at proper rates, some of the bioactive agents - such as quillaja extract, tannic acid, ionophore antibiotics and lecithin - also showed potential as protozoa-reducing feed additives.”

However, it was sunflower oil specifically that researchers chose for use in the study’s final experiment, in part because of its high linoleic acid content, and its overall effectiveness at eliminating protozoa from the rumen.

“Our research demonstrated that replacing six percent dry matter of a barley-based feedlot finishing diet with sunflower oil improved average daily gain in steers by about 13 percent and feed efficiency by approximately seven percent, in addition to improving overall carcass grade.”

“Replacing six percent dry matter of a barley-based feedlot finishing diet with sunflower oil improved average daily gain in steers by about 13 percent and feed efficiency by approximately seven percent.”

- Dr. Tim McAllister

Supplemental protein recommendations don't pencil out

CABIDE PROJECT
35

Gains not worth extra cost to producers.

Supplemental protein in a good barley-based beef feed ration can increase rate of gain in cattle, but it may not be worth the extra cost of production, say researchers.

Two years of research at three sites in Edmonton and southern Alberta indicate that using supplemental protein at rates recommended by the National Research Council (NRC) can increase rates of gain in cattle. However, the economics of

achieving that gain don't pencil out for producers.

The findings are part of a three-pronged study that looked at types, timing and amounts of supplemental protein in beef cattle rations.

"The bottom line of the two-year study was that the supplemental protein actually increased production costs."

- Dr. Tim Guichon

The project was launched to evaluate the 1996 NRC protein recommendations, which say that increasing crude protein in rations by 1.5 percent (on a dry matter basis) will increase the performance of feedlot cattle.

"Our advice to feeders is there's no economic advantage to feeding supplemental protein in a standard barley-based ration," says Dr. Tim Guichon, with Feedlot Health Management Services of Okotoks, who along with colleague Dr. Calvin Booker, looked at a key aspect of the research – the economic return of feeding 1 to 1.5 percent supplemental protein in the form of urea or canola meal, to feedlot animals.

Those findings were confirmed in a similar project led by Dr. Erasmus Okine of Alberta Agriculture, Food and Rural Development, who looked specifically at the need for extra protein in winter. "We found our cattle very efficient at using protein in cold weather," says Okine. "The take-home message is that the NRC has over-estimated the need for protein in its recommendations."

Research by Dr. Karen Beauchemin and Dr. Karen Koenig of the Agriculture and Agri-Food Canada Lethbridge Research Centre confirmed that supplemental protein increases activity of rumen microbes that produce protein and ultimately the amino acids an animal uses for growth.

Beauchemin notes the NRC recommendations are designed to produce a biological response and are not intended to show an economic response. However, the research data will help fine-tune computer nutrition models that ultimately help livestock nutritionists formulate rations.

Fighting odour while harnessing nutrients

"Simple management practices can minimize exposure to odour and gases emitted from feedlots and land-applied feedlot manure."

- Dr. Sean McGinn

CABIDE PROJECT
36

Use simple management practices to reduce odours and emissions in beef manure while preserving its ammonia content.

Easy management practices can help reduce odours and harmful emissions from livestock manure while preserving its valuable nutrients for fertilizing, concludes this study.

Dr. Sean McGinn, a scientist with the Lethbridge Research Centre, says distancing livestock and manure-applying operations from residential areas, changing diets and feedlot design and manure spreading methods are helpful to reducing emissions and odours.

"Employing these simple management practices can minimize exposure to odours and gases emitted from feedlots and land-applied feedlot manure," says McGinn, who led the study of commercial feedlots in the Lethbridge area over a two-year period.

Among the many findings in McGinn's study, which tested for 14 odourants, tilling manure-applied soil after application reduced ammonia losses up to 76 percent, while irrigating reduced these losses up to 21 percent.

On feedlots, reducing stock density, piling manure and adding a small amount of water in pens with a drainage slope to avoid volatile fatty acid growth also reduces emissions. McGinn's study also notes that keeping operations outside the one-kilometer minimum separation distance will reduce the impact of odours on residential areas.

Despite the positive findings, McGinn says more research is needed to study the impact of gases exceeding threshold irritant levels, particularly during high-concentration periods in the early mornings and evenings, and the effects of dust from livestock manure on odour and human health.

Definition of high growth genes in beef cattle

CABIDF PROJECT
56

Major step to boost productivity of the Canadian herd.

Cattle genomics research holds tremendous promise to unlock the blueprints for animals that use less food, finish better and produce less waste. In this study, researchers identified several genes associated with “high growth” in beef cattle, which will help the industry improve productivity through early identification of animals with the genetic fortune to carry this valuable trait.

“The objective was to use some innovative approaches to develop molecular markers for high growth potential in beef cattle,” says Dr. Bernie Benkel of Agriculture and Agri-Food Canada’s Lethbridge Research Centre. “We identified many chromosome regions that were significantly associated with birth weight and average daily

gain on feed. At least three of these genes show significant associations with growth traits and warrant further investigation for the development of direct markers for growth traits.”

Molecular markers are pieces of DNA that repeated analysis shows are closely linked to the presence of genes that

control a specific trait, such as growth potential, explains Benkel. The advantage is that these markers are easier to identify than the genes themselves, making them a powerful selection tool.

Currently, scientists have limited information on specific genes affecting growth in cattle, says Benkel. However, since the genetic make-up of all mammals is similar, researchers can borrow information from the genome map of one species and apply it to another. “It appears that genes which perform a certain function in humans or mice, frequently have a very similar if not identical function in cattle,” says Benkel. “We can use that information to predict which genes in cattle control economically important traits, such as growth in this case.”

“This program, in collaboration with groups around the world, will build the foundation onto which all the genes in cattle will be identified and sequenced.”

- Dr. Bernie Benkel

Dust-busting systems for feedlots

CABIDF PROJECT
59

Dust management and irrigation system curb spread of harmful aerosols and dust.

A dust management and irrigation system can reduce the distribution of harmful aerosols and dust from feedlots, reports a new study.

“This research project was designed to measure dust particles and microbial populations in the air from feedlots that are under different dust management systems,” says Dr. Abimbola

Abiola, a researcher with Olds College, who led the Picture Butte-area study.

Abiola says any facility handling livestock manure, municipal solid waste and compost is a source for airborne biological contaminants,

which can include pathogens, particulates and chemical pollutants. These contaminants, including their odours, can be easily spread through the air, affecting air quality within a half-kilometre radius of the source.

The study researched two feedlots upwind of Picture Butte. One used a dust-management system, which is a surface irrigation sprinkler, and the other does not. Air samples were taken from the feedlots and the town of Picture Butte to test for dust particles, yeast, molds and total and fecal coliforms (bacteria) in various sizes.

“The dust levels in the feedlot with an irrigation dust management system were significantly lower than those in the facility without it,” says Abiola, noting the feedlot with a system had a lower count than Picture Butte, where dust was attributed to traffic and construction.

Abiola’s study also reports that air samples containing total and fecal coliforms were only found at the feedlots and not in Picture Butte. All collected samples were under the threshold limit values.

“Feedlots have shown to have little effect on the microbial air quality outside a half-kilometre radius.”

- Dr. Abimbola Abiola

Chair strengthens Alberta beef research base

CABIDF PROJECT
23

Supporting the province's leadership position internationally.

Research and development of new technology is crucial to ensuring Alberta's place as a key player in an increasingly global economy. It's also essential for the beef industry to maintain a leadership position on the competitive global stage.

For these reasons, two new research chairs in beef production were established in the areas of beef cattle genomics and enzymology.

A key part of the research chair initiative is encouraging teamwork among molecular biologists and other scientists

from Alberta institutions, helping to build a world class research program in Alberta in the rapidly evolving area of molecular biology.

The two research chairs are Dr. Stephen Moore, at the University of Alberta, who has concentrated on progress in feed efficiency, and Dr. Doug Inglis, at the Agriculture and Agri-Food Canada Lethbridge Research Centre, who has concentrated on progress in enzymology. (See Moore's related CABIDF project #57 in the Manure Sustainability section, and Inglis' related CABIDF projects #58 and #61 in the Beef Marketability section.)

Alberta brain gain

CABIDF PROJECT
24

Visiting scientist program under CABIDF brings expertise to benefit Alberta's beef industry.

To remain competitive in a global market, the Alberta beef industry must continue to expand its research base and the development of new technology. Part of achieving that goal is to share knowledge and forge strategic links with renowned international researchers.

The CABIDF-supported visiting scientist program supported this effort by bringing several prominent scientists to the province, lending expertise and building relationships in areas such as manure management, the ethics of animal welfare, food-borne pathogens and beef productivity.

"Each of the visiting scientists brought an immediate benefit to Alberta's beef

industry by sharing their knowledge with beef researchers, producers, extension and industry," says Dr. Brian Freeze of Agriculture and Agri-Food Canada, who coordinated the visiting scientist program. "But the full benefits

have sown seeds of knowledge that Alberta will continue to reap for many years to come."

Here's a quick look at four important areas that benefited from the visiting scientist program.

Animal welfare

The visiting scientist program was designed to bring leading scientists to Alberta to discuss major issues affecting the agriculture industry. One of the key emerging issues has been meeting society's increasing awareness and concern for animal welfare.

To provide insight into the issue and what it means for Alberta's beef industry, the visiting scientist program brought in Colorado State University philosopher Dr. Bernard Rollin. An acknowledged world leader in animal ethics, Rollin was responsible for writing key laws governing the use of laboratory animals in the United States.

"The visitors presented seminars and workshops throughout the province, interacted with Alberta scientists, shared information on their own research and provided fresh perspectives on research and industry issues."

– Dr. Brian Freeze

will be realized long-term. By offering their expertise, fresh perspectives and ongoing relationships, these scientists



Rollin says producers shouldn't concern themselves with the more radical elements in the animal rights movement who are demanding an end to use of all animals, even pets, because they have little credibility with the public. Producers should, however, recognize social attitudes have changed about the use of animals.

The challenge facing agriculture is to reassure people the food they eat is raised in a humane fashion, he says. "People want animals to live decent lives. Then they'll eat meat without guilt." Rollin met with a broad cross-section of people involved with the Alberta cattle industry, including researchers, cattle feeders, Alberta Agriculture representatives and producer organizations, to give a series of lectures on animal welfare and comparative bioethics.

Manure management

Another, higher profile issue for the industry is manure management. The visiting scientist program brought to Alberta Dr. Jessica Davis, a manure

management expert from Colorado State University.

Davis was a leading researcher in helping Colorado deal with substantial manure management challenges. In Alberta, she used that knowledge to draw comparisons and offer recommendations to help the province benefit from the lessons learned in Colorado. This included identifying gaps in manure management research,

conducting two case studies on Alberta feedlots and sharing results from those case studies at producer and extension-oriented meetings.

"We need to take a proactive approach," Davis observed, noting many similarities between Colorado and Alberta. "That means industry has to work closely with other sectors, including research scientists, to determine specific strategies for sustainable manure management. "When one segment of the industry or one geographical area battles another, everyone loses."

Food-borne pathogen

On the food-borne pathogen front, Dr. Todd Callaway of the USDA Food and Safety Research Unit was brought to Alberta to share knowledge on his team's leading edge research toward strategies to reduce the threat of *E. coli* O157:H7.

Dr. Callaway and his team examined the effect of ionophores on the *in vitro* survival of *E. coli* O157:H7, a study that complemented further work to

examine the effect of monensin and tylosin on the shedding patterns of *E. coli* O157:H7 in beef cattle in Alberta. They also researched the use of sodium chlorate as a method of reducing the shedding of *E. coli* O157:H7 in ruminants, a strategy that could be readily implemented in commercial feedlots, and also researched the use of bacteriophages to mitigate the pathogen.

"A reduction in fecal shedding of *E. coli* O157:H7 by cattle through diet modification or dietary intervention prior to slaughter may reduce numbers of *E. coli* O157:H7-positive animals entering slaughter plants and subsequently increase the safety of Canadian beef," says Callaway.

Beef productivity

Beef productivity was another key area that benefited from the program. Dr. Mark Nelson of Washington State University was brought to Alberta, to share his knowledge on the impact of supplemental fat on high concentrate diets and the effect of fatty acids on ruminal protozoa.

Both areas are important strategies that have been proposed to get the best balance between preventing acidosis and maximizing productivity in cattle fed high concentrate diets.

"Oils and fats moderate acidosis by slowing the rate of acid production in the rumen," observes Nelson. "And the provision of organic acids can shift fermentation in a manner that reduces the production of the acids, resulting in the greatest decline in rumen pH."

These factors can be used in the design of superior dietary strategies.

New tool to keep riparian areas healthy

CABIDF PROJECT

8

Researchers have a practical health assessment system.

Ranchers and producers with a new respect for riparian areas will benefit from research done by the Cows and Fish Partners including Alberta Sustainable Resource Development. Barry Adams, Regional Range Manager, Public Lands Branch, Alberta Agriculture, Food and Rural Development led the research team to provide landowners with the tools to measure and ensure the health of these fragile ecosystems.

A riparian area is a portion of land that is influenced by free water, including streambanks, riversides, wetlands and sloughs. The moisture regime in these areas gives rise to riparian vegetation, such as sedges, rushes and willows. Riparian areas recharge aquifers and dissipate stream and flood energy, all important functions in the ecosystem.

"These areas are valuable to agriculture, but grazing, cattle impact, urbanization, logging and road construction can threaten riparian health," says Adams.

The Cows and Fish research team from Canada and the United States completed a project evaluating riparian health in southern Alberta and have developed a user-friendly riparian health assessment system. Landowners can assess their riparian health, using the *Health Assessment for Streams and Small Rivers – Field Workbook* created from this research; they can also attend workshops and training sessions offered throughout Alberta.

"If you consider the dry prairie landscape, only about two percent makes up riparian areas, but these areas significantly support about 80 percent of the fish and wildlife species," Adams says. "The bottom line is, these areas are very important to everybody."

"We're building a strong understanding of the current status of riparian function or health for a number of riparian ecosystems, and our provincial understanding is expanding."

- Lorne Fitch (Co-investigator)

Keeping a lid on *E. coli*

CABIDF PROJECT

25

Persistence points to importance of feedlot waste management.

The strong persistence of *E. coli* and other bacteria in cattle manure and liquid effluent illustrates the importance of proper management to reduce the risk of environmental contamination from cattle feedlots, concludes this study.

E. coli and other bacteria can survive in manure and catch basin effluent for up to several months, says Dr. Jim Miller of



Agriculture and Agri-Food Canada's Lethbridge Research Centre. Miller examined the persistence of bacteria and nutrients in feedlot manure as part of a broad three-year project that investigated the links between feedlot manure, water quality and human health.

"The bottom line is manure and liquid effluent need to be managed properly," says Miller. "In different components of our study, we found that *E. coli* and other types of bacteria can survive anywhere from several days to several months in manure and effluent, so proper management is essential to ensure these bacteria are not transferred to the environment."

The study also uncovered significant variations in manure nutrient levels at different times throughout the year. Amounts of manure phosphorus and nitrogen varied from month to month, at levels significant enough to consider when spreading manure on land.

"This shows the importance of nutrient testing to help match manure application rates to soil and crop requirements," says Miller.

Water-borne parasites a complex issue

CABIDF PROJECT
26

Agriculture likely one source among several.

Grazing cattle and related livestock activities can be major contributors of parasites and bacteria in streams, rivers and other water sources, but they are not the only sources of contamination, says the co-ordinator of a three-year study of the North Saskatchewan River Basin, west of Edmonton.

Livestock and runoff from livestock operations need to be managed to minimize the impact of agriculture on surface water, says research leader Sandra Cooke, a water quality

biologist formerly with Alberta Agriculture and Rural Development in Edmonton.

The research team monitored water quality within an area of the North Saskatchewan River Basin, a 14,000 kilometre area of forest and farmland, between Edmonton and Rocky Mountain House. The study focused on two main protozoa parasites, *Cryptosporidium* spp. and *Giardia* spp. intestinal parasites that can infect mammals, including humans.

“We addressed two main questions in this project,” said Cooke, “Do cattle in cow-calf operations contribute significant amounts of *Cryptosporidium* and *Giardia* to surface water compared with wildlife and municipal sewage effluent? And do watersheds with high densities of cattle and other livestock contribute greater quantities of *Cryptosporidium* and *Giardia* to the North Saskatchewan River than forested watersheds?”

Concentrations of *Cryptosporidium* and *Giardia* were significantly higher in streams draining from watersheds with more intensive agricultural (livestock) production, compared with non-agricultural watersheds.

“It appears that livestock are a significant source of parasites in the river. The question that still needs to be answered is ‘Are these parasites of the genotype that could significantly impact human health?’”

- Sandra Cooke

Composting reduces manure volume for easier transport

CABIDF PROJECT
27

Helps operators get past the “bulls eye” for broader land application.

The modern boom in Canada’s beef business created many lucrative opportunities, but also resulted in a major challenge – how to manage the multi-million tonnes of manure churned out annually by beef feedlot operations.

In this study, researchers examined the potential of composting, one of the most promising management options. They found that composting can reduce manure volume by up to 70 percent, allowing for more cost efficient transport to nutrient-deficient areas for land application. They also examined chemical changes associated with composting different types of materials, which will lead to improved strategies for managing manure nutrients.

“The results demonstrate that composting is a viable option for feedlots interested in producing a product that can be transported more economically than fresh manure,” says Dr. Frank Larney of the Agriculture and Agri-Food Canada Lethbridge Research Centre. “It also provides numbers for nutrient changes during composting of feedlot manure, that heretofore have not been available for southern Alberta situations.”

Due to the cost and added management of hauling manure to outlying areas, most fresh manure is spread on land adjacent to feedlots, says Larney. “This gives rise to the so-called ‘bullseye’ effect, where soil test levels for N and P are very high close to feedlots and diminish with distance.”

Overall, the study provides some real numbers on composting, says Larney.

“This will help producers make decisions on whether to use composting as an alternative means of handling manure.”



“The key advantage of composting is that you don’t waste money by hauling non-nutrient material.”

- Dr. Frank Larney

Maximizing manure on forage

CABIDF PROJECT
28

New information to boost application strategies.

Solid beef manure can be surface-applied to forage crops, without sacrificing soil and forage quality, or crop yield, say Alberta researchers.

"Many beef producers also have forage crops, but there is

little information on applying manure to those crops," says Lawrence Papworth, an engineer with Alberta Agriculture, Food and Rural Development. "We found that beef manure application affects soil properties, and forage yield and quality, but it also provides an additional benefit to beef producers searching

"Nothing in our research indicates that producers shouldn't apply manure to forages, but too much may actually depress growth"

- Lawrence Papworth

for further manure management options that allow them to remain profitable, productive and environmentally responsible."

Key findings include:

Soil chemistry. Producers should use a low manure application rate and regularly test soil to prevent a significant nutrient buildup.

Plant tissue quality. Manure application affected almost all of the measured plant tissue quality parameters in alfalfa and Timothy, though increases tended to be more pronounced in Timothy.

Effect on yield. For alfalfa, manure application had relatively little effect on yield in 1996 to 1998, regardless of manure type or time of application. That began to change in 1999. That year, most manure treatments yielded significantly higher than the control and in 2000, all manure treatments yielded higher than the control. However, after four or five years of annual application, there was no nutrient advantage to applying anything greater than the lowest rate, 31 Mg/ha on a wet-weight basis. Similar results were observed with Timothy.

New model to maximize manure application

CABIDF PROJECT
29

K-model predicts long-term nutrient processes.

Soil profile, climate and plant growth play a key role in determining environmentally safe and economical rates of manure application for land, which can make determining appropriate application rates a complex process.

Now, researchers have developed a new model to help simplify that challenge. Dr. Xiaomei Li of the Alberta Research Council and colleagues performed a three year intensive soil profile and climate analysis concerning the major soil types in Alberta, then used that information to develop a K model to help guide application decisions.

The K model provides producers with a practical means for the sustainable management of cattle manure, says Li. "The information we generated here is intended to help producers maximize

application rates, while taking environmental and economic factors into account."

The model is a producer-focused, site-specific computer model; producers will be prompted to enter information about their operation into the model. The computer program will then make suggestions based on soil condition, plant growth, and climate.

"Soil organic carbon and nutrient dynamics involve complex interactions between substrate, soil microorganisms, as well as the physical, chemical environment of the soil," says Li.

"Sound, reliable, mathematical models are essential to understanding these complex soil processes."

"Sound, reliable, mathematical models are essential to understanding these complex soil processes."

- Dr. Xiaomei Li



Protecting groundwater under sandy soils

CABIDF PROJECT
37

Higher risk of leaching is deterrent to production.

Routine irrigated farming practices using feedlot manure on coarse-textured soils can contribute to high nitrogen and phosphorous levels in groundwater, says Dr. Cathryn Ryan, a University of Calgary hydrogeologist.

Monitoring nutrient levels in ground and surface water on a southern Alberta farm during the one-year project, Ryan found it only takes a small fraction of leached nutrients to contaminate groundwater above drinking water standards.

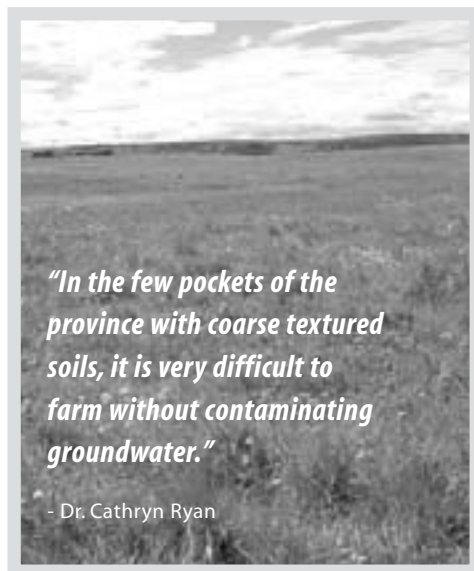
The study showed nitrogen levels in groundwater “well exceeded” Canadian standards for drinking water. And although there are no drinking water objectives for phosphorous, there were also high levels of the phosphorous in groundwater.

Ryan found nitrogen and phosphorous levels were high in groundwater throughout the

year. While this project didn’t specifically look at surface water, the nutrient levels in an adjoining irrigation canal were high on a seasonal basis, mostly through the winter and early spring period.

“The research applied specifically to irrigated farming on coarse textured soils,” notes Ryan. “This was a vulnerable setting, with coarse sandy soil, a shallow water table, under irrigated farming practices.” Feedlot manure was applied to the site at conventional rates, although Ryan notes the rates were likely higher than what would be recommended in a nutrient management plan.

“Over most of the province, with finer textured glacial till soils, it isn’t a problem,” says Ryan. “But in the few pockets of coarse textured soils, it is very difficult to farm without contaminating groundwater.” With finer textured soils Ryan would expect the nitrogen to be more likely denitrified or be held in the soil in the form of nitrate. Also, finer textured soils don’t tend to be underlain by sediments that have useable groundwater.



“In the few pockets of the province with coarse textured soils, it is very difficult to farm without contaminating groundwater.”

- Dr. Cathryn Ryan

Alberta model for best application rates

CABIDF PROJECT
38

Helps assess phosphorus mobility, protect water quality.

A model that can predict phosphorous (P) runoff from agricultural operations throughout the province offers producers greater ability to manage their own operations sustainably. The research has also resulted in solid conclusions about the suitability of current agronomic soil tests for measuring P.

Research conducted in Alberta in the late 1990s showed that P levels in surface water were too high in many areas, especially in areas with moderate or high agricultural intensity, explains Dr. Dan Heaney, former head of the agronomy branch of Alberta Agriculture, Food and Rural Development.

However, that research did not evaluate the specific agricultural activities that might have contributed to the high levels. As such, producers were left without any concrete information as to how to manage their operations in a way that might reduce phosphorus loading following manure application.

While a province-wide standard for soil test P was proposed, the industry was adamant that such a standard wouldn’t be appropriate in Alberta where there are many different soils, slopes and rainfall patterns.

“The one size fits all approach isn’t appropriate when determining P limits for Alberta soils,” says Heaney. “If the livestock industry in this province wants to be sustainable while undergoing expansion, it needs site specific management tools for P, and P

mobility and movement. We’re confident our research will put the industry well on its way to being able to assess the risk of P movement and mobility, and what it means for siting operations and managing existing ones.”

“We’re confident our research will put the industry well on its way to being able to assess the risk of P movement and mobility, and what it means for siting operations and managing existing ones.”

- Dr. Dan Heaney

Better measuring stick for feed efficiency

CABIDF PROJECT

41

Poised to revolutionize evaluations and save millions in feed costs.

Cow-calf and feedlot producers value the day they can confidently select cattle that require less feed to produce the same amount of beef. That day is closer now that a group of Alberta researchers have demonstrated that a new tool - net feed intake - is a solid measure of feed efficiency.

Feed represents one of the largest costs of beef production, typically second only to fixed cost in importance to the bottom line of most operations, says Dr. John Basarab, Western Forage Beef Group, Alberta Agriculture, Food and

Rural Development.

"Improving feed efficiency is critical to maintaining the competitiveness of the Canadian beef industry with the rest of the world and other livestock sectors as well."

"In the past, we selected for a faster-growing, larger animal with increased appetite, but no better in terms of feed efficiency."

- Dr. John Basarab

Using net feed intake as an indicator may help revolutionize the

way feed efficiency is measured in cattle and, for the first time, allow for selection of truly efficient animals, says Basarab. Net feed intake refers to the difference between an animal's actual feed intake and its expected requirements for feed and growth. For instance, a British-cross steer with a 453.6 kg bodyweight gaining 1.76 kg per day on a finishing diet has an expected feed intake of 14.5 kg per day, according to the National Research Council's Nutrient Requirements for Beef Cattle. However, if the actual feed intake for the steer were 10.2 kg per day, 4.3 kg less than expected, the net feed intake would be -4.3 kg per day.

"Like a golf score, a negative value is better and indicates an efficient animal," he says. "In the past, it was thought if cattle were selected for improved average daily gain, feed efficiency would follow. But what seems to have happened is that we selected for a faster-growing, larger animal with increased appetite, but no better in terms of feed efficiency."

Sniffing device tackles odour

CABIDF PROJECT

42

New eight-port parallel "olfactometer" boosts results, saves cost.

Improved technology to measure odour from beef production will make measurement simpler, faster, more cost effective and efficient.

The newly designed, eight-port olfactometer provides an objective, reliable and accurate measurement of odour, says Dr. Richard Coleman, formerly of the Alberta Research Council. "By providing objective odour analysis in reduced time, the new olfactometer is a tool that will benefit the entire beef industry."

An olfactometer distributes neutral air samples mixed with varying levels of a target gas. A panel of trained participants sniff the air from the olfactometer and indicate the point at which they begin to detect odour. Based on these levels, researchers can then establish an odour threshold for the gas.

"The new olfactometer represents a significant improvement over previous models," says Coleman. "With a single port olfactometer, only one person can 'sniff' at a time. Considering that each test needs to be run with eight participants, testing takes a tremendous amount of time. The new eight-port olfactometer sharply reduces testing time and therefore cost because it allows eight participants to 'sniff' simultaneously."

The new eight-port olfactometer reduces the possibility of odour contamination because, with the exception of a 1/4-inch of tubing connected to the sniffing funnel, components for the neutral air are never in contact with those for the odorous air, explains Coleman. In conventional designs, all tubing, chambers, and valves after and including the sample-assignment device can be assigned to either neutral air or odour samples, therefore increasing the risk of odour contamination.

Getting the facts on air quality

CABIDF PROJECT
43

Results show feedlot air quality within standard limit for livestock facilities.

Research found that microbial population levels in feedlot air, though higher than air upwind of the site, are generally within the standard threshold limit values set for livestock facilities. The study has also provided a better understanding of the movement of feedlot air.

Understanding the distribution of air from feedlots – which could contain biological entities, such as bacteria and dust – is

important in reducing liabilities and encouraging acceptability of feedlots and current manure management strategies, says Dr. Abimbola Abiola of Olds College. “Greater acceptance of feedlot facilities and beef production in general in Alberta will help the industry reach its full potential with fewer environmental concerns from the general public.”

The extensive research project was designed to determine whether feedlots are contributing to microbiological contamination of surrounding air. A total of 5,400 air samples were taken from two feedlots in the windy Chinook region of Alberta over two years.

The recommended limit for total bacteria in the air is 10,000 cfu/m³ according to the American Conference of Government Industrial Hygienists. The study found that while microbial populations in the feedlot were generally at an elevated level when compared to upwind air quality, the levels were generally within the standard threshold limit value set for livestock facilities.

“These results will help the industry reach its full potential with fewer environmental concerns.”

- Dr. Abimbola Abiola

Targeting *E. coli* in the feedlot

CABIDF PROJECT
49

Adding chlorine to the water trough may reduce exposure to *E. coli*.

A three-year study has uncovered a promising new option to minimize the exposure of cattle to *E. coli* O157:H7, reducing public food safety concerns.

The study found that adding chlorine to cattle drinking water may reduce exposure to *E. coli* O157:H7, cutting off the pathogen before it can enter the food chain, says Dr. Janice Berg from Lakeside Farm Industries Inc.

“We have found that this simple, proactive approach sharply reduces bacterial populations in drinking water before they have a chance to infect cattle,” says Berg. “The potential benefits of this inexpensive management practice are enormous.”

Overall *E. coli* concentrations in chlorine-treated water samples were about 80 percent lower compared to untreated samples. As well, in reducing total *E. coli* in the water, chlorination was three times more effective than cleaning troughs every two days.

Because the pathogen was not detected in any of the fecal samples, the researchers were unable to determine whether chlorination reduced *E. coli* O157:H7 infection. Since the cattle were exposed to fewer bacteria as a result of chlorination, Berg is hopeful the treatment will have a beneficial effect.

Further studies are needed to determine optimum treatment methods, says Berg. “Chlorination does reduce *E. coli* levels, but we need more information on the effect it has on the *E. coli* O157:H7 in the cattle.”



Model to manage phosphorus runoff

CABIDF PROJECT

54

A revolutionary way to prevent runoff into surface water.

Scientists have developed a precise, site-specific, manure management model that will help producers across Alberta manage Phosphorus (P) runoff into surface water. The Soil P-Export model (SPEM) is a computer model designed for producers to use on-farm.

Phosphorus in runoff is sometimes linked with the contamination of fresh water bodies and surface runoff

from agricultural land is recognized as a contributing factor. Until now there has been no way of quantifying the amount of runoff.

"We needed a straightforward model that would produce accurate results."

- Dr. Xiaomei Li

"Our hope is that producers will use information from this computer model to make judgments on appropriate phosphorus application," says Dr. Xiaomei Li, an Alberta Research Council scientist.

The highest potential for accelerated contamination of water bodies occurs in areas with intensive livestock operations. The stumbling block previous models ran into was the variation between operations with respect to soil type, topography and other variable factors. Li's team recognized the need for a model that applies to all operations across Alberta.

Producers will be prompted to enter information about their operation into the computer program and SPEM will provide them with a number defining the amount of P runoff. Producers can then compare their numbers to standards set by regulating bodies and adjust their farming practices accordingly.

Genes pinpointed to ramp up net feed efficiency

CABIDF PROJECT

57

Leaving more dollars in producers' pockets.

When it comes to profitable cattle feeding, most factors pale in comparison to the cost of feed. That's why genomics researcher Dr. Stephen Moore and colleagues went searching for ways to increase cattle production profits, and quickly settled on a mission to better understand the genes that affect feed intake and efficiency.

"The cost of feed has been shown to be the single largest determinant of profitability for a beef cattle enterprise," says Moore, Chair of Beef Genomics at the University of Alberta. "In view of this, this series of studies focused on improving our understanding of the

"This research is an important step toward targeted strategies for the improvement of feed efficiency in cattle."

- Dr. Stephen Moore

genes and gene pathways affecting feed intake and efficiency."

The researchers uncovered several promising results that will contribute to genetic strategies for developing cattle with greater feed efficiency. Among these, they examined differences among breeds with respect to genes

that influence feed efficiency, identified and/or mapped genes and gene pathways that play a role in various aspects of carcass fat and meat yield, clarified the relationship between residual feed intake and feeding duration, analyzed genes involved in the regulation of obesity and feeding behaviour, and analyzed genes that control energy partitioning.

"This research is an important step forward," says Moore. "Further research and analysis of gene expression patterns will help to expand and develop our understanding of bovine digestion. This will lead to targeted strategies for the improvement of feed efficiency in cattle."

BEEF MARKETABILITY

Beef Marketability Projects include #'s 44, 45, 46, 51, 52, 58 & 61. For more information on each project, go to the Web site at www.albertabeef.org/cabidf

Strengthening beef markets

CABIDF PROJECT
44

A three-year research project headquartered at Alberta's Food Processing Development Centre in Leduc, involving more than a dozen industry partners, will bring a range of new beef-based products, as well as improved food processing, storage and packaging technology to Canadian and international consumers over the coming months and years.

Although the momentum of the project was curbed by the May 2003 BSE issue, it still was very successful in developing new products and technologies, says Robert Gibson, head of the operations branch at the Leduc centre.

The program worked with companies such as Canada Safeway to develop improved fresh beef handling methods, with Highland Feeders of Vegreville to develop quality-enhanced BBQ-ready steaks and other cuts, and with Centennial Foods of Calgary to develop quality-enhanced beef products that will be used as ingredients by other food processors.

"We worked with more than a dozen large and small companies to develop improved products and technologies," explains Gibson. "The overall goal was to develop products and processes that would improve the marketability of Alberta beef. The

benefits of this work will be realized as these and other new products are brought to the marketplace."

Along with working with industry partners to develop new beef-based products, another aspect of the program involved adapting technologies from other countries that would benefit the Canadian beef industry.

"This particular program served as seed money to kick-start new ideas, but product development is an ongoing process."

- Robert Gibson.



Get more information on all projects

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Paving the way for safer beef

CABIDF PROJECT
45

Carcass breaking research pinpoints key pathways to stop disease transfer.

This research points to the beef carcass breaking process as a major source of disease-causing bacteria, not the carcass dressing process, as is often thought to be the case.

The research findings led Dr. Colin Gill, of the Agriculture and Agri-Food Canada Lacombe Research Centre, to believe that redesigned carcass breaking equipment could significantly

reduce the levels of *E. coli* contamination, and therefore result in safer beef.

“Merely keeping the product and the carcass breaking equipment dry will reduce the risk of contamination.”

- Dr. Colin Gill

“Traditionally, efforts to prevent beef contamination have focused on the carcass dressing process or the cattle before they come

for processing,” says Gill. “But, we believed that the risks of bacterial contamination could be linked to disease-causing bacteria deposited on meat during the carcass breaking process.”

Because beef is pasteurized after the carcass dressing process, very few *E. coli*-infected carcasses enter the breaking facilities; however, that hasn't completely eliminated the *E. coli* threat. Since *E. coli* tend to reappear on the meat after carcass breaking, Gill decided to take a closer look at the carcass breaking process.

Based on the results, Gill suggests that carcass breaking equipment be redesigned to improve cleanability, to ensure that the equipment can be wholly cleaned during each working day. Carcass breaking equipment is currently not designed to be cleanable. In the interim, though, Gill says merely keeping the product and the carcass breaking equipment dry will reduce the risk of contamination.

“There's also some inadequacy with our dependence on the HACCP process for avoiding contamination,” he adds. “Current HACCP systems at beef packing plants emphasize the visible cleanliness of beef carcasses and therefore may fail to control the microbiological contamination of beef.”

In the future, Gill suggests that appropriate microbiological sampling be used to determine whether equipment is adequately clean and not the current method, which is largely based on inspection of meat contacting surfaces for visible cleanliness.

‘CLA’ offers dramatic human health potential

CABIDF PROJECT
46

Revolutionary cancer-fighting enzyme to boost consumer perception of beef.

Scientists, using microbiological methods, isolated an enzyme responsible for producing conjugated linoleic acid (CLA) in cattle. CLA is expected to add tremendous health benefits to Canadian beef and dairy products. In the past decade, CLA has been touted as a revolutionary cancer-fighting enzyme.

“The production of beef with enhanced nutritional properties is exciting,” says Forster, an Agriculture and Agri-Food Canada researcher based in Lethbridge, who led the research. “CLA has been recognized as an important fatty acid that has anti-carcinogenic properties and is linked to cancer prevention, among other things. Because of its health benefits, CLA has received widespread attention in the popular media.”

Studies have indicated that CLA has inhibitory effects on human malignant melanoma, colorectal, breast and lung cell lines. It has also been shown to increase immune function and normalize glucose levels in rats with non-insulin dependant diabetes.

This finding has tremendous opportunity for the beef industry because foods derived from ruminant products are the best source of dietary CLA.



“Researchers now have access to a unique resource, the purified linoleate isomerase enzyme, that will allow for further study of CLA.”

- Dr. Bob Forster

Markers to predict marbling

CABIDF PROJECT
51

Bonus health benefits also uncovered.

Researchers identified potential genetic markers to help Alberta's beef industry identify and select animals at a young age that will produce highly-marbled beef. One of those potential markers, oleic acid, a fatty acid known to reduce cholesterol in humans, may also boost beef's image as a healthy food product.

These results are key steps toward increasing the market value of Canadian beef."

- Dr. Randall Weselake

"Both of these results are key steps toward increasing the market value of Canadian beef," says lead researcher Dr. Randall Weselake. "Consumers are recognizing the value of well-marbled beef, and markers will help improve this trait in Canadian herds. The oleic acid finding is a spin-off benefit that may enhance the consumer perception of beef as a healthy food product."

Markers are essentially "molecular fingerprints" that make it easier for researchers to identify valuable genetic traits, such as high marbling potential, says Weselake. Markers can be anything from proteins, such as enzymes, to genetic material, such as pieces of DNA. They consistently indicate the presence of a sought-after gene, but are generally easier to identify than the gene itself.

Along with oleic acid, potential markers identified included an enzyme, hormone-sensitive lipase, and two fatty acids, myristic acid and palmitic acid. All showed a significant positive association with marbling score, and further studies are planned to confirm their predictive value.

"Consistently producing well-marbled beef is seen as key for the Canadian beef industry to further expand its markets, particularly in Pacific Rim countries like Japan," says Weselake.

'Good' bacteria stop beef spoilage and pathogens

CABIDF PROJECT
52

Molecular genetics shine light on potential.

Researchers isolated a strain of lactic acid bacteria (LAB) with the potential to reduce meat spoilage and contamination by food-borne pathogens such as *E. coli* O157:H7 and *Listeria monocytogenes*.

Dr. Frances Nattress of the Agriculture and Agri-Food Canada Lacombe Research Centre, and colleague Dr. Christopher Yost used molecular genetics to identify LAB populations that grow on vacuum-packed meat. While LAB are commonly associated with meat spoilage, the researchers were able to identify specific "good" LAB strains that actually protect against spoilage by outcompeting the "bad" ones.

"We already knew that certain strains of LAB contribute to meat spoilage," says Nattress. "But this research has given us more specific information about how that happens and has led to the identification of a strain that actually inhibits spoilage by competitively excluding other strains. It also shows potential for reducing the numbers of food-borne pathogens. In the future, this strain could be introduced into vacuum-packaged meat products to improve quality and safety."

The best performing good strain, a single *Leuconostoc* strain, was identified and isolated using DNA sequencing. Using molecular typing methods, researchers will further probe the benefits of this *L. gelidum* on vacuum-packaged meat. "Eventually we may be able to introduce *L. gelidum* to the beef industry as an 'ingredient' that could improve the product," concludes Nattress.

"The spoilage of vacuum-packed meat is a \$200 million per year problem for the Canadian beef industry."

- Dr. Frances Nattress

Cutting down *Campylobacter*

CABIDF PROJECT

58

Reducing incidence in feedlot cattle lowers risk of transfer to humans.

Campylobacter species, particularly *Campylobacter jejuni* and *C. coli*, are one of the most common causes of acute diarrheal disease (campylobacteriosis) in humans throughout the world, including Canada.

Currently, poultry are thought to be the primary reservoir of *campylobacters* infecting humans. However there are strong indications that cattle are a major source as well.

To get a better handle on the *Campylobacter* situation in cattle and support mitigation strategies, researchers in this study developed a Polymerase Chain Reaction (PCR) test to detect the pathogen in bovine faeces.

“The ability to directly quantify the biomass of *Campylobacter* species will enhance our understanding of their biology and facilitate the development of effective mitigation strategies,” says Dr. Doug Inglis of the Agriculture and Agri-Food Canada Lethbridge Research Centre.

Specifically, the results will help provide a major roadblock to prevent the transfer of *Campylobacter* pathogens from cattle to the environment and to humans, he says. “The techniques we’ve developed are essential for the development of methods that prevent the colonization of the gastro-intestinal tracts of cattle, and thereby eliminate the release of this important group of human-pathogenic bacteria in cattle faeces.”

*“We feel that shedding of *Campylobacter* by cattle is an emerging issue that we have the opportunity to address in a proactive manner.”*

- Dr. Doug Inglis

Managing bacteria and maximizing feed efficiency

CABIDF PROJECT

61

Using biotechnology to increase sustainability of beef production.

Dr. Doug Inglis, the CABIDF research chair at Agriculture and Agri-Food Canada, Lethbridge, led a team of researchers in using biotechnology to enhance the sustainability of beef production. The project focused on two areas: (1) enhancing fibre breakdown using rate limiting microbial enzymes; and (2) managing release of human-pathogenic bacteria in cattle faeces.

Researchers identified a bacterium that produces an active enzyme that may be used to increase the utilization of recalcitrant plant fibre by cattle and thereby increase digestive efficiency. The identification of this enzyme will

have a significant impact on the utilization of low-value feeds.

Inglis and his team also used biotechnology to gain further insight into *campylobacters* associated with the intestines of

“Biotechnology has allowed us to increase our chances of sustaining beef production.”

- Dr. Doug Inglis

cattle – *campylobacters* are a group of intestinal bacteria similar to *E. coli* in that they can infect humans and cause gastroenteritis. Even though infections caused by *Campylobacter* do not receive widespread attention in the media, they are recognized by scientists as one of the most frequent causes of diarrheal disease in humans throughout the world, including Canada. Understanding how this group of bacteria colonize cattle intestines and which factors influence their release in faeces is important for the development of effective methods to decrease their impact on humans.

“When considering the long-term sustainability of the beef industry, we must anticipate potential problems and increase efficiency whenever possible,” says Inglis. “That’s what this research attempted to accomplish.”

Managing intestinal pathogens in cattle and maximizing digestive efficiency have the potential to add value to the beef industry by decreasing the possibility of illness caused by *campylobacters*, and by increasing profit for producers through more efficient feed utilization.



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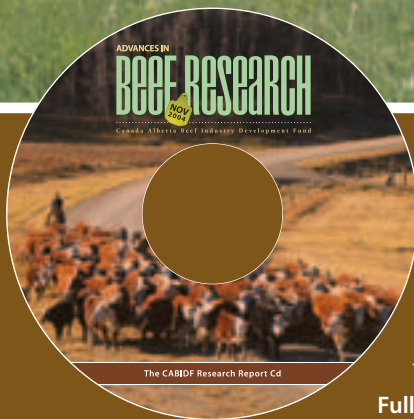
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