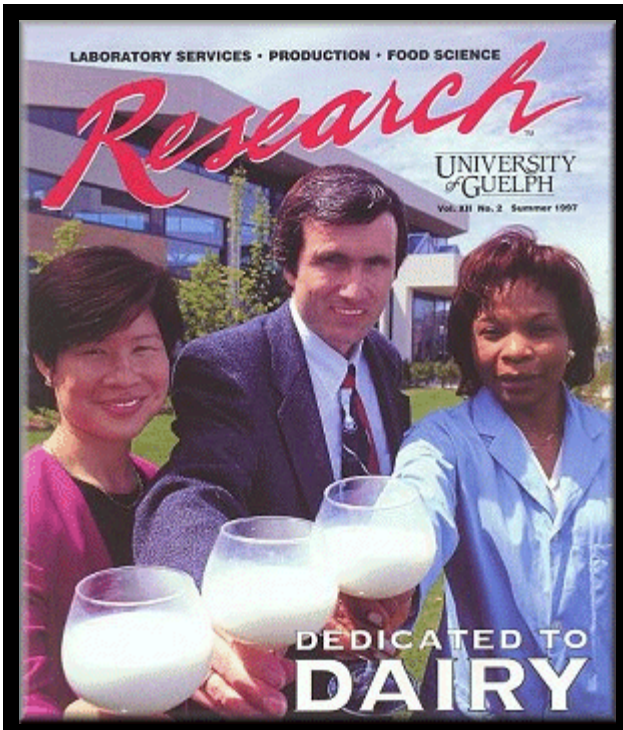


Research™ UNIVERSITY of GUELPH

Summer 1997
Volume XII, Number 2

Guelph Food science professor Art Hill joins analytical services manager Dr. Arlene Yee (left) and senior scientist Dr. Temitope Ayanbadejo of Laboratory Services for a toast to dairy research . . .and to the enhanced partnership that unites their research.

See story. . .

In this issue...

Trina Koster

Student research writer Amina Ali, project co-ordinator for this dairy research publication, stays close to her "sources."

Volume XII, Number 2
Research
Summer 1997

Acknowledgements

RESEARCH PARK CENTRE
UNIVERSITY of GUELPH

UNIVERSITY of GUELPH
LABORATORY SERVICES

Purity above all else

by Sarah Haines


Trina Koster

Laboratory Services technician Tracy MacDonald performs gold-standard protein calibration analysis.

When it comes to milk, purity rises above all else. And that's why the University of Guelph's Laboratory Services division is in the dairy industry's corner.

Laboratory Services is formerly the Ontario Ministry of Agriculture, Food and Rural Affairs' (OMAFRA) Agricultural and Food Laboratory Servi c es and Veterinary Laboratory Services Branch. It's one of the five institutions * that joined the university through an enhanced partnership with the ministry in April 1997. The division's home base is an 88,000-square-foot state-of-the-art lab next to the new OMAFRA headquarters.

Laboratory Services has an analytical, regulatory, research co-ordination and animal-health mandate. Its expansive milk-testing program is by far its largest regulatory focus, making up nearly half of the centre's entire budget.

"Laboratory Services is unique in that it combines innovative research with standard province-wide milk-testing functions," says the division's research manager, John Lynch.

The lab tests milk samples from more than 7,000 dairy producers across the province. Fifteen samples are collected randomly from every farm each month. One goes for regulatory testing, four are for compositional testing and 10 are available for special investigations as information samples or for research purposes. The entire testing program sees a whopping two million samples pass through Laboratory Services' facilities every year.

Regulatory testing. Provincial regulations dictate milk's purity -- and Laboratory Services is the purity checkpoint. Technicians check for the presence of antibiotic residues, bacteria, added water and somatic cells in milk samples. One research focus investigates a microbial hazard called verotoxigenic *E. coli* or "hamburger disease," which is also found in milk. Laboratory Services has adopted new technologies that increase the accuracy and sensitivity of verotoxigenic *E. coli* identification.

Compositional testing. Health-conscious consumers want milk with less fat. That has driven the dairy industry to pay producers for other components such as various types of protein and lactose, in what's called a multi-component pricing system. "When measured against traditional milk testing, which simply quantified fat percentages, the new system, which analyses fats, proteins and carbohydrates in milk, is comparatively rigorous," says Lynch. In addition, new analyses to identify specific types of vitamin levels have recently been developed.

Research. Lynch says the availability of producer samples for research gives scientists a highly accurate perspective of the industry. For example, one research program involving Laboratory Services and the Ontario Veterinary College is examining iodine levels in milk, which may be influenced by the use of anti-microbial teat washes and teat dips on the farm.

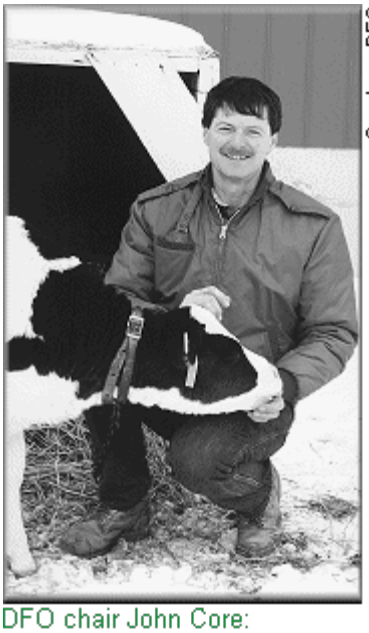
"We broaden our knowledge base for dairy research when we link up producers and scientists," says Lynch. "Collaboration between Laboratory Services and the university is key to maintaining high standards of milk quality."

Laboratory Services is certified by the Standards Council of Canada and recently became the first public-sector analytical laboratory to be awarded International Organization for Standardization (ISO) 9002 status, signifying global standards of excellence in quality and safety testing. High-speed testing systems based on gold standards of chemical analysis, technologies unavailable elsewhere under one roof and an evolving team of top-notch scientists -- including dairy science pioneers like Les Szijarto -- have enabled this centre to specialize in a broad spectrum of research.

***The University of Guelph's new partners are Laboratory Services, the Horticultural Research Institute of Ontario and the agricultural colleges at Alfred, Kemptville and Ridgetown.**

Profitable markets and product excellence

by Amina Ali


Courtesy DFO
DFO chair John Core: anticipating innovative changes.

International trade agreements, reduced inter-provincial trade barriers, government cutbacks and changing consumer preferences have milk producers wondering where the industry's headed. Now, they're taking action to figure it out.

The Dairy Farmers of Ontario (DFO) is helping chart its own course by spearheading a $800,000 chair program in dairy policy research at the University of Guelph.

As a leading policy analyst, the chair will have the crucial responsibility of providing leadership for the rapidly changing marketing environment of dairy products. A search is on now for a candidate.

The DFO is committed to a vision of growing profitable markets and promoting product excellence within a progressive supply management system, says DFO chair John Core.

"We hope the chair will assist the industry in examining and adopting new dairy marketing policy approaches," he says. "That will lead to innovative changes and will ensure a bright future for the dairy industry."

Helping fuel this initiative is the Agricultural Adaptation Council's CanAdapt program. For the next four years, CanAdapt will match every dollar from the DFO; after that, the DFO will fully fund the chair program with $200,000 annually.

The DFO and U of G dairy policy chair partnership enhances the long standing relationship between the two, at a time when industry support and involvement in university programs are becoming increasingly critical.

The chair search committee is led by Prof. Truman Phillips, acting chair of the Department of Agricultural Economics and Business. Other members are Profs Alfons Weersink and Kimberly Rollins, Agricultural Economics and Business; graduate student Danny LeRoy; food science professor Marc LeMaguer, project leader for the Ontario Ministry of Agriculture, Food and Rural Affairs/U of G research programs; Core; and Wes Lane, DFO director of communications, administration and planning.

Phillips says the committee is looking for a dairy policy chair who can find ways to increase competitiveness, identify alternatives to enhance producer and processor efficiency, and foster long term growth.

"This is a very enlightened initiative," he says. "Dairy producers' are showing

they're open to pursuing research that provides a sincere answer about what's happening to the dairy industry."

Getting a jump on dairy

by Sarah Haines

Victor Wong

Building on the basics - in science and facilities - keeps food science chair Rick Yada motivated.

Milk is often called nature's perfect food, but to scientists, it's one of nature's greatest mysteries. They think they've only begun to tap its potential. By using "jump technology" and state-of-the-art facilities -- the focus of a new capital campaign at the University of Guelph -- researchers are ready to take milk to a new level.

"Jump technology," means using traditional food such as milk and other dairy products as ingredients for non-food industries such as pharmaceuticals, cosmetics and packaging.

Food Science chair Rick Yada says this jump to expand milk beyond its original uses as food ingredients or products will translate into new and profitable opportunities for the dairy industry. Such diversification is considered central to the future direction and expansion of the dairy industry, which is already Ontario's largest agri-food sector with annual sales of $1.4 billion.

Jump technology requires an unprecedented understanding of fundamental food processes.

"A back to the basics approach is needed to make problem solving and new product development easier within the dairy industry," says Yada. "Milk has been around forever, yet we still don't know everything about it."

With the only accredited food science program in Ontario, Guelph's Department of Food Science has become the industry's leading teaching and research locale. To meet the demands for an integerated approach needed to support the industry into the next millennium, a capital campaign is under way to raise $1.2 million to outfit laboratories, classrooms and offices in the 75-year old building with state-of-the-art equipment. When combined with other funding sources, the initiative will net a total of $10.4 million for capital improvements.

The Food Science building is a logical -- and traditional -- place for dairy research.

Food science at Guelph began in 1886 when the Ontario Agricultural College established a program in dairy science. The program found a home in the dairy science building, which today is known as the Food Science building.

The department has grown to include specialists in food chemistry and physics, materials science, meat science, industrial microbiology, food safety, food packaging and food processing engineering. The innovative research being explored within dairy science today -- much of which is described in this issue of *Research* -- includes the use of milk proteins as food ingredients, the development of rapid identification techniques for pathogens, improving frozen food stability,

and the chemical modification of milk enzymes to improve the taste of cheese.

Yada says this breadth of activity in Food Science is further prompting the University to upgrade the facility.

"As a growing number of companies choose the Department of Food Science for research, it's essential that we have the proper environment for success," he says.

HOME CONTENTS PREVIOUS NEXT

Mastering Mastitis

by Sarah Haines


Van Dusen Stock Photography

The Ponsonby Dairy Research Station provides top-grade testing facilities for mastitis control.

A quick home test to help producers and veterinarians decide the course of mastitis treatment for their cows is being evaluated by U of G researchers.

Clinical mastitis -- a condition characterized by an inflammation of the udder and decreased milk production -- has burdened dairy producers for decades. University of Guelph researchers at the Elora and Ponsonby Dairy Research Stations are responding to this costly disease, by evaluating a new HyMast Culture System, to help producers diagnose mastitis on-site.

"This on-site test will allow producers and their veterinarians to determine the necessary treatment for mastitis in a cost-effective and timely fashion," says Dr. Jocelyn Jansen, a doctor of veterinary science candidate in the Department of Population Medicine.

The need for continued support of this research is clear. At least one in every five dairy cows experiences a case of mastitis during lactation. Significant losses include discarded milk, lost production, premature culling, increased labour, costs of veterinary services and decreased genetic gain.

Mastitis is traditionally treated with antibiotics, but it's suspected these drugs may result in increased antibiotic residues in milk. Recently, it has been suggested there may be a link between antibiotic use in agriculture and increased antibiotic resistant bacteria implicated in human disease. So, the public is demanding the more targeted use of antibiotics in livestock.

The new HyMast test system -- a simple milk vile which has a paddle embedded with two different types of growth media (gram positive and negative organisms)-- can determine whether antibiotic treatment is necessary for cows suffering from mastitis.

Just take a milk sample, incubate it, and results will be ready within 24 hours. This system, which determines the bacterial agent associated with clinical mastitis, acts as a decision-making tool. If there is growth on the gram positive side of the paddle -- signifying *Staphylococci* and *Streptococci* bacteria -- antibiotics are recommended. But if there is either no growth on the paddle, or growth on the gram negative side -- meaning the presence of coliforms -- antibiotics are considered ineffective.

The study of this technology began last fall. It involves about 26 herds, including 200 cows from the Elora and Ponsonby Dairy Research Stations, and should be completed in the spring of '98. Milk producers value Elora and Ponsonby for their

rich tradition of research and dynamic atmosphere, where university and industry meet to solve problems and create solutions that help keep Ontario producers so competitive.

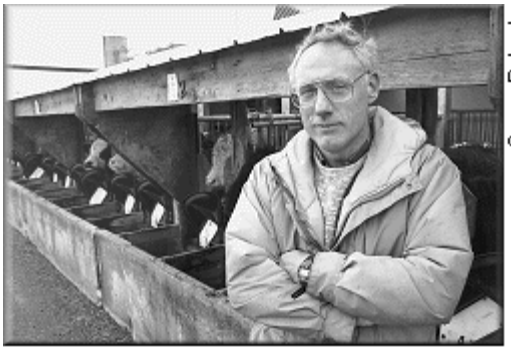
The HyMast test, which was developed in Israel, has been on the market in North America since last fall. But its economic and biological potential has yet to be realized. Jansen, who is working with population medicine professors Ken Leslie and David Kelton, is optimistic about this new technology.

"Alternative treatments must be recognized and adopted to maximize efficiency for the dairy industry," she says. "With the development of the HyMast Test as an effective aid for decision-making, a rational therapy-targeting approach shows great promise."

HOME CONTENTS PREVIOUS NEXT

Breeding in a changing environment

by Marc Lazenby and Polly Stanley


Owen Roberts

Jim Wilton and CGIL help Canadian dairy producers stay ahead of the pack.

Exciting opportunities are arising for dairy researchers working to genetically improve livestock. They've been brought on by recent changes in funding of livestock improvement programs in Canada.

An initial benefit to the dairy industry is improved business partnerships between the people who are developing enhancements to livestock improvement programs and the organizations that provide these products and services to dairy pro ducers in Canada and around the world.

A key player is the Canadian Dairy Network (CDN), which was formed in 1995 by the Canadian Dairy Breeds, the Canadian Association of Animal Breeders and the Canadian Milk Recording Board. CDN is a privatized version of the formerly government-run domestic genetic evaluation program. In co-operation with the various national breed associations, CDN also maintains a database of pedigrees and records on all Canadian dairy cattle.

"The formation of CDN has given the dairy industry more input in research and development priorities," says Prof. Jim Wilton, director of the Centre for Genetic Improvement of Livestock (CGIL).

CGIL researchers, based at the University of Guelph, are involved in many facets of dairy cattle improvement. Work has been done and is continuing in the areas of milk recording, conformation and production evaluations of artificial insemination (AI) s ires, and the conversion of international sire proofs to a common base.

For close to 50 years, researchers in the Department of Animal and Poultry Science (and later CGIL) have calculated genetic evaluations for the conformation of dairy cattle as a service to the Ontario government and the Holstein Association of Canada (HAC). This prior work has led to a formal working arrangement with the CDN. The network continues to co-ordinate the type evaluations and the provision of research and development initiatives.

The partnership with CDN has given CGIL researchers the opportunity to focus their research and development efforts on all the economically important traits of the dairy cow.

"One of CGIL's objectives is to try to create efficient animals with the fewest possible health problems," says Wilton.

CGIL's work is done by a large group of research scientists, some of whose projects are described in this issue of *Research*

CGIL keeps its research and development work relevant through continual communication with CDN, producer groups and industry partners such as Holstein Canada, the newly formed Semex Alliance and other breeding organizations.

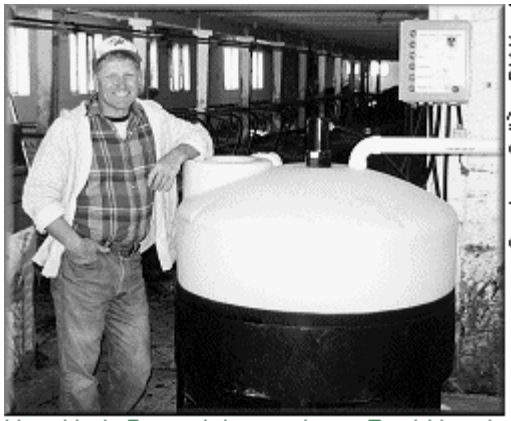
A changing genetic evaluation industry has led to increased opportunities for researchers at CGIL. They've seized the opportunity to develop a business relationship with CDN and are creating new methods of evaluating and calculating animal performance.

The work of CGIL researchers is beneficial to all Canadian dairy producers; their efforts increase the amount and accuracy of the information producers have on their animals. This allows them to make more informed genetic selection decisions, thereby i mproving the animals in their herd and increasing the efficiency and sustainability of their operations. This results in increased profits for Canadian dairy producers and expanded worldwide exports of genetic material.

HOME CONTENTS PREVIOUS NEXT

Safely managing milkhouse waste

by Christine Black


Courtesy Collège D'Alfred

New York State dairy producer Fred Huneke is managing milkhouse washwater with the help of a flocculator from Collège d'Alfred.

Dairy farmers can start washing their hands of milkhouse wastewater, thanks to research that is making disposal safer than ever before.

Ian Malcolm and William Kollaard, engineering researchers at Collège d'Alfred, have found a way to clean up milkhouse waste in Canada's dairy industry.

They've spent four years researching, developing, and testing various methods to deal with milkhouse washwater. As a result, they've come up with a small chemical reactor, called a "flocculator", that is making waves in milkhouse washwater disposal.

"The flocculator is a valuable innovation because the system can remove up to 99 per cent of the harmful phosphorus, as well as most of the milk residues left behind in wastewater," says Kollaard. "That makes the final disposal more reliable."

Milkhouse washwater has posed a problem in the dairy industry for years. To keep Canada's milk supply among the safest in the world, farmers wash their equipment and holding facilities after each milking. But this wash water is laden with phosphorus which can contaminate nearby surface waters. In addition, fat from milk residues clogs tile fields. Replacing clogged septic systems or manure storage capacity creates added expenses.

But with the Collège d'Alfred flocculator, things are looking up. The flocculator is the first chemical treatment system on the market and works by combining washwater and lime in a tank. An agitator mixes the contents of the tank, causing the phosphorus and fat particles to collide and bind to the lime (a process called flocculation).

Once the agitation stops, the bigger, heavier particles settle, allowing most of the original volume of washwater to be discharged phosphorus- and fat-free from the tank. The remaining sludge is then added to the existing manure system.

"The volume of washwater that has to be stored is dramatically reduced using the flocculator," says Kollaard. "Not only are the phosphorus and fat particles removed, but the remaining water can potentially be recycled."

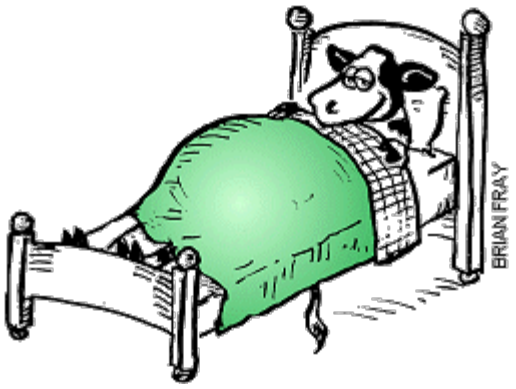
Thirteen dairy farmers are housing individual units on site. With site testing done in Ontario, Quebec, New Brunswick, Nova Scotia, and New York state, the flocculator is now being marketed worldwide.

The flocculator requires a six-foot square space and will cost about $6,000 to install.

Preliminary research on the flocculator was sponsored by the Ontario Ministry of Environment and Energy, the Ontario Ministry of Agriculture, Food, and Rural Affairs, and the Dairy Farmers of Ontario. On site systems are funded by individual producers with the help from numerous conservation programs.

Cows vote for comfort

by Polly Stanley



Dairy cows are lying down on the job -- at least when there's a mattress underfoot -- say Kemptville researchers.

Dennis McKnight, Jonathan Morgan and Paul Sharpe from the animal science section at Kemptville College recommend that producers consider mattresses for dairy cow housing. Their suggestion stems from a study comparing six different bases for use in free stalls -- and their finding that dairy cows preferred commercially available livestock mattresses to any other base.

Their research was initiated in response to producers' demands for practical alternatives to an earthen base. Producers want something that's inexpensive and easy to maintain, while providing comfort and safety to the cows.

"Free stalls with an earthen base can provide excellent comfort and safety for the dairy cow," says McKnight, "but maintaining an earthen base is an endless and burdensome chore. An alternative is needed."

The Kemptville Dairy Research Station recently renovated a slatted-floor beef feedlot into free-stall housing for dry dairy cows. This provided a unique opportunity to test a variety of free-stall bases and their effects on animal care.

McKnight and his team measured the maintenance requirements and visual appearance of the bases over 11 weeks. Next, they did trials over 39 days in which two cows with no previous experience in the pen were free to choose among stalls with all six base types. The cows' preferences were determined by the number of times each stall was entered, the cows' positions in the different stalls and how long they held each position.

Finally, the researchers looked at which stalls the cows chose in a competitive situation, when there were the same number of stalls as cows.

Here's what they found. Daily scrapings of stalls and weekly application of wood shavings were all it took to maintain an acceptable appearance of each base type. In general, they found that everyday maintenance requirements were highest for mattresses and lowest for clay. But this was simply a reflection of how often each base type was used.

When cows had access to each stall base in a non-competitive situation, they chose the stalls with mattresses most often. And they tended to lie down -- a general indicator of comfort. This also held true under competitive circumstances. In fact, in those trials, the mattress-based stalls were occupied more than 85 per cent of the time. The remaining cows had no choice but to take an alternative.

The researchers didn't assess hock injury (a joint in the hind leg) or swelling in their research. But previous studies have reported greater risk of swollen hocks on mats compared with mattresses.

"Based on this research, we suggest that dairy farmers consider installation of cow mattresses in free-stall dairy barns," says McKnight. "Maintenance requirements are low, and if the decision were up to the cows, they would choose mattresses."

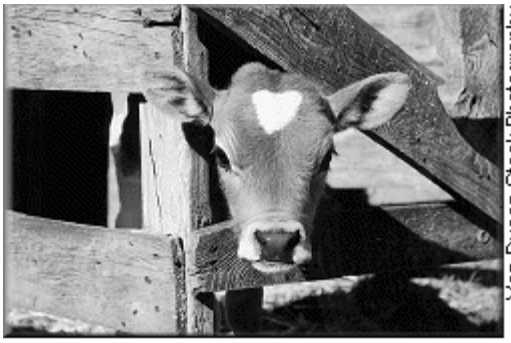
This research was sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs.

HOME CONTENTS PREVIOUS NEXT

The most neglected nutrient

Water's role in milk production is under the microscope

by Christina Clark


Van Dusen Stock Photography
Water is a nutritional cornucopia for dairy cows, regardless of breed.

Researchers are working to make the effects of water quality on milk productivity crystal clear.

Water looks pretty simple, but it contains all kinds of nutrients. And because it makes up 87 per cent of the milk produced by cows, water can have a big impact on quality milk production.

Vern Osborne of the Department of Animal Science at Ridgetown College is studying the water-intake behavior of dairy cows. Lactating cows drink up to 100 litres of water in a day, but few studies have concentrated on the effects of water quality on milk production.

"Water is the most neglected nutrient when it comes to dairy production," says Osborne.

He's looking closely at the effects of water properties on cow productivity. His goal is to establish the relationship of factors such as water temperature and mineral content to milk production, cows' health and reproduction.

Water characteristics can vary greatly from one community to the next and even between neighboring farms. The levels of chemicals, bacteria and pollutants in water are not uniform across the country.

Osborne wants to know if these differences can significantly affect milk productivity. His research will enable him to identify what nutrients in the water positively -- or negatively -- affect dairy production. Then, water-delivery and -filtration systems could be designed to enhance water quality so that dairy farmers can supply their cows with the best water possible.

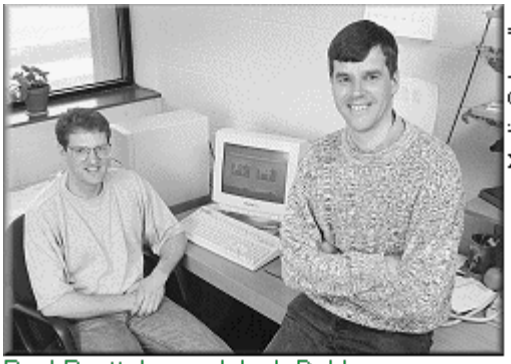
"We want to circumvent the negative factors in water so that the cows are drinking pure water of the highest quality," he says.

Information from Osborne's epidemiological study on water quality in Canada and how it relates to the on-farm performance of cows could be used in the future to supplement cows' diets with nutrients through the water. In this way, water could act as a vehicle for feeding the cows electrolytes, amino acids and other essential components of a ruminant's diet.

This research is sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs and the Dairy Farmers of Ontario.

Keeping four feet firmly on the ground

by Amina Ali


Martin Schwalbe

Paul Boettcher and Jack Dekkers are securing the footing for cows' feet and legs.

Cows' feet and legs cope with a lot of stress, making them more prone to disease and reducing their functionality. U of G researchers want a measure of genetic predisposition to foot and leg disorders added to genetic evaluations of Holstein cattle to reduce the incidence of disease, decrease veterinary bills and improve animal welfare.

Animal scientists Paul Boettcher and Jack Dekkers are relating the occurrence of foot and leg disorders in dairy cattle to their underlying genetic component.

"We're looking at different aspects of foot and leg structure to identify existing problems or the potential for disease and dysfunctionality," says Boettcher.

Cows fed a diet low in fibre and high in energy to promote lactation, are susceptible to laminitis -- a disease caused by damage to the blood vessels in their hooves. Up to 30 per cent of cows have subclinical laminitis, minor bleeding that doesn't affect their movement, but another five to 10 per cent of cows with laminitis develop a limp or other clinical symptoms.

Currently, the Holstein Association of Canada evaluates dairy cows for conformation traits; physical characteristics such as height, weight and shape of the udder; and a few feet and leg traits. Boettcher's work is designed to add additional feet and leg traits that are more accurate indicators of resistance to disease than other traits are.

"These experiments will allow us to confirm the economic importance of foot and leg disorders for breeding purposes," he says.

The second stage of the research involves applying the data to select for positive foot traits and relating them to greater disease resistance. At present, the total economic value index that can be used to select genetically superior bulls and cows includes milk production, mastitis resistance and longevity criteria. The new data will be used to develop an index of traits to predict strong resistance -- a high ability to fight off disease -- in relation to the economic value of traits related to disease and functionality of feet and legs.

International interest in this work is also high. Guelph is among the first to consider the importance of foot and leg disorders for dairy selection indexes. Canada is already at the starting block with the results of this research because the Holstein Association of Canada already has an effective program to record conformation traits and the infrastructure is in place.

Canadians -- whether they're producers, agribusiness leaders or consumers -- will benefit. The health of cows gets top priority, but a reduced disease incidence also

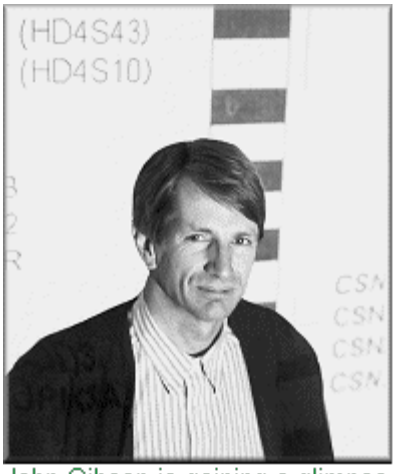
means fewer antibiotics will be used and drug resistance is kept at bay.

"If our cows build on their reputation for needing less maintenance, the Canadian agricultural industry is sure to gain," says Boettcher.

This research is funded by the Cattle Breeding Research Council, the Natural Sciences and Engineering Research Council, the Holstein Association of Canada and the Ontario Ministry of Agriculture, Food and Rural Affairs.

New technologies help to breed the cow of the future

by Jeff Stuart



John Gibson is gaining a glimpse into the bovine genome.

By speeding up the selective breeding process and applying the latest reproductive and molecular tools, U of G researchers are enhancing milk productivity and dairy profits.

Animal science professor John Gibson and his colleagues are combining reproductive technologies with genetic markers to give dairy farmers even more control over the quality of their herd.

"For the first time we can look inside the genetic black box," says Gibson. "And what we find in there will lead to a new era of genetic improvement."

Genetic screens have been developed for many deleterious genes that cause very specific and identifiable problems. Genetic screens are limited, however, by the need for specific problematic genes to be identified, a laborious and expensive process. With more than 70,000 genes comprising the genetic makeup of an individual animal, the identities of the vast majority of genes responsible for particular characteristics remain unknown.

So, Gibson and Yves Plante at the University of Saskatoon are undertaking a collaborative research program, using genetic markers. Genetic markers identify a specific region of the genome containing possibly hundreds of genes. The presence of these markers can be matched to any number of desirable traits. Better yet, the identity of the individual genes need not be known. Researchers can just follow the occurrence of the genetic markers over a few generations of a bull's offspring, and correlate the presence of the marker with the many measures of a good dairy cow, like milk quality and quantity. Using this approach, specific genetic markers can be linked with a database of characteristics.

The genetic markers can be detected in very young animals -- even in embryos -- which can then be selected for further testing or breeding. This is where recent advances in reproductive technologies come in. Using *in vitro* fertilization and embryo transfer, elite cows and bulls can rapidly be produced from selected offspring. There's no need to wait for animals to mature to measure desirable characteristics in adults; the presence of the genetic marker in young animals indicates that the animal will be genetically superior and can pass this superiority onto its progeny.

"These molecular and reproductive tools will help farmers breed the cow of the future, which will be healthier and more productive and give better quality milk," says Gibson.

This research is sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs, the Cattle Breeding Research Council, the Natural Sciences and Engineering Research Council and the Saskatchewan Research Council.

Better models, better genetics

Dairy evaluation procedures are being improved by researchers

by Amina Ali

A new procedure developed by U of G researchers is helping to improve the accuracy of dairy cow genetic evaluations.

Some of the best animals have failed to rank as producers expected. That prompted animal science professor Larry Schaeffer and postdoctoral students Janusz Jamrozik and Fernando Grignola to create computerized statistical models to improve genetic evaluation methods for production (milk solids, fat and protein content) traits.

Central to the models is a new procedure called the test day method, developed by Jamrozik. It improves the accuracy of predictions, especially when lactation records are incomplete.

"Increasing the evaluation frequency will benefit producers," says Schaeffer. "By adopting the test day method, they'll experience fewer fluctuations in the evaluations of their herds over time."

The test day method is a monthly recording system for milk. About 10 test day records are collected during the 305 days a cow milks. An overall average is then calculated to complete the record. This provides better accuracy than the previous total milk recording systems, which weren't done as often. Canada has recently increased the number of test day evaluations conducted from biannually to quarterly.

Some dairy producers have on-farm computers recording the weight of milk produced daily. Increasing the involvement and participation of these farmers will improve progeny testing records by filling gaps in the data. Schaeffer says this benefits all dairy farmers because comprehensive records allow scientists to predict how productive the daughters of sires will be.

Since 1988, 10 million test day data records have been collected. One million more are collected each year. As the data banks grow and the numbers are crunched, producers gain from better progeny predictions -- a goal all dairy genetics scientists strive to achieve.

The Canadian Dairy Network (CDN) in Guelph is responsible for all genetic evaluation in Canada. Currently, 60 per cent of Canadian dairy cows are sampled.

Schaeffer says farmers co-operate willingly to help the industry.

"The economic impact of genetic evaluations of dairy herds is enormous," he says.

"A Producers could stand to gain or lose up to $25,000, depending on where their top bulls rank against other Canadian Holsteins."

As international markets for dairy continue to open up, it has become even more important to predict how sires will do. And that's what Schaeffer's work allows.

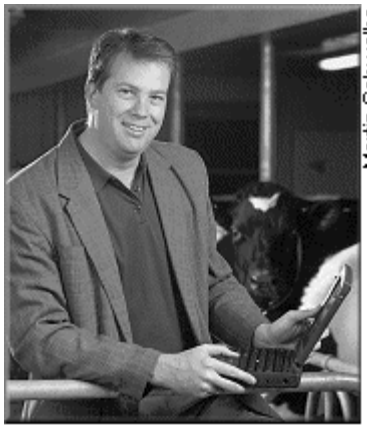
"The new models will help provide dairy producers with better tools for selecting genetically superior animals that are profitable," he says.

Support for this research is provided by the Canadian Breeding Research Council and the Natural Sciences and Engineering Research Council.

HOME CONTENTS PREVIOUS NEXT

Balanced breeding for bigger bucks

by Christina Clark


Martin Schwalbe

Dairy selection indexes can mean bigger dairy profits, says Mike Lohuis.

Dairy breeders are reaching for the top, thanks to a new selection index pioneered by researchers at the University of Guelph.

When it comes to selecting a sire, producers consider all kinds of traits, and indexes help them rank the bulls as best as they can. An index considers the traits that are deemed to be most important and translates these into an economic value for farmers. A number of different indexes are available depending on the producer's specific herd objectives, which are ultimately aimed at improving farm profitability.

"Many dairy breeders use the Lifetime Profit Index (LPI), which closely follows Canadian breed associations' goals," says animal-breeding strategist Mike Lohuis.

This index places 60 per cent of the emphasis on production traits such as the protein and fat yield of the milk produced by daughter cows. The remaining 40 per cent considers conformation traits, also known as "type" traits, like as mammary system and feet and leg conformation.

LPI has been in place in the dairy industry for many years, but Lohuis says it's less suitable for large farms. These producers have been asking for an index that's more economically based, and U of G has answered their call.

In 1996, animal science professor Jack Dekkers introduced the Total Economic Value (TEV) index to translate all available information of economic importance into a dollar figure, for farmers to rank bulls from highest to lowest.

This index is divided into three main components -- production traits (64 per cent), herd life (26 per cent) and udder health (10 per cent). Herd life is an estimate of how long the cow will be an active part of the herd, based on survival data and conformation traits. The udder health component takes into account somatic cell scores -- an indicator of freedom from diseases of the udder -- and will soon incorporate other udder type traits.

Lohuis and researcher Balan Sivanadian looked at the performance of a variety of indexes, and TEV came out on top. But based on their findings, they also have three recommendations for large herd producers when selecting sires.

First, they found that the choice of index is not the most important thing to consider.

"The debate about whether TEV or LPI is better is much less important than choosing the top bulls in a given index," says Lohuis.

Second, high selection intensity drives up the profit margin for producers. The

problem is that selecting from the top one per cent forces farmers and artificial insemination companies to consider using special breeding strategies such as multiple-ovulation embryo transfer (MOET). This tactic, pioneered by U of G animal science professor Charles Smith, is used by many dairy companies in their efforts to increase genetic progress.

Finally, the best index depends on the cows' environment. Lohuis and Sivanadian found that differences existed between cows in a commercial population and those in a registered or purebred population. LPI, for example, is less appropriate in a commercial than in a purebred environment.

Lohuis suggests large operators looking for an index consider TEV, but keep his recommendations in mind.

HOME CONTENTS PREVIOUS NEXT

Hidden assets

Researchers isolate genes to help find top performers among breeds

by Jenny Tye


Patty Jones / Jersey Canada
Jersey cows like these are among the breeds being studied.

The discovery of genes that play a major role in immune function will soon allow farmers to select for "unseen" health performance traits in improved breeding strategies.

University of Guelph doctoral student Surinder S. Saini, along with pathobiology professor Azad Kaushik, is learning more about the construction of the bovine immune system and how to enhance immune competence in dairy cattle.

The researchers have isolated genes that will provide them with markers to reliably distinguish between different dairy breeds and accurately pinpoint animals with the genetic capacity for good health. This and similar technology from Kaushik's laboratory will also open doors to genetic engineering possibilities, as well as to new disease prevention strategies in dairy cattle.

"Animals are currently selected for visible traits and productivity," says Kaushik. "The advent of antibody gene markers will allow farmers to select for the presence or absence of specific unseen gene patterns that are associated with immune competence."

Kaushik and his team are targeting the gene expression of a certain region of the antibody molecule.

An antibody is a protein molecule circulating in blood that protects an animal against invading pathogens. The functional part of the antibody molecule -- called the variable region -- is the part that binds and neutralizes the foreign agent, called the antigen. Rearranging the genes that lead to the expression of -- or "code" for -- this region results in antibody diversity. This is essential for host-disease defence.

For his study, Saini identified up to 15 genes that code for a specific part of this antibody region in four breeds of cattle -- Holstein, Jersey, Hereford and Charolais. He characterized and cloned the genes and developed DNA probes that can be used to quickly target these genetic sites.

Using these probes, Saini mapped the gene patterns of the different cattle breeds, which he's now using as accurate predictors of each breed's genetic ability to resist disease.

The isolation of antibody genes now makes it possible to develop transgenic cattle that produce specific desired antibodies. Transgenic animals would be created by inserting a specific antibody gene that confers resistance to a certain disease into

the embryonic DNA of another animal.

In addition, the researchers hope to develop specific genetically engineered antibodies to add to colostrum ("first milk") supplements for newborn calves. This could be used to prevent diseases such as calf scours, which is newborn-calf diarrhea.

"As the productivity of animals increases, their disease susceptibility also increases," says Kaushik. "Farmers are seeing a rise in many economically damaging diseases. Part of the problem is that as farmers are breeding for high productivity, they are inadvertently breeding for low disease resistance. We hope our work will provide ways for farmers to find a balance between herd productivity and health."

This research is sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs and the Natural Sciences and Engineering Council of Canada.

A firm foundation for ice cream

Good Humour helps researchers learn how to build a superior product

by Lucia DeStefano


Martin Schwalbe

Food science students (from left) Julie Arthur, Sarah Grant, Joanne Soetemans and Tanya vander Ploeg perfected dairy delicacies at College Royal '97.

Like the blocks of an igloo, the ice particles in your favorite dish of butterscotch ripple give it a firm foundation that promotes good texture, quality and stability.

Food science professors Doug Goff and Doug Dalgleish and PhD student Kevin Segall are in the midst of a three-year-long project with Good Humour Breyers Canada, a subsidiary of Unilever in the United Kingdom, designed to improve the structure of ice cream.

"This is a good demonstration of university and industry collaboration in fostering knowledge that is useful to the partners and us," says Goff.

The researchers are exploring the structure established by fat and protein in ice cream when subjected to various processes and in the presence of different ingredients. By carrying out this background research, they will enable manufacturers to develop new and better products for consumers.

"Our forte at the university is the development of science and contribution to the overall knowledge of product development practitioners in the food industry," says Goff. "Our group is writing another chapter in the book on ice cream structure."

Ice cream contains four separate phases -- ice crystals, air bubbles, fat globules and an unfrozen serum phase. Each phase comes with its own unique set of problems. The researchers have found that the fat and protein together are responsible for a structural element that leads to smooth texture and good melt-down properties. Added emulsifiers also play a role. They're examining these interactions to gain a better understanding of the role of proteins in ice cream structure. They've shown that incorporating stabilizers greatly enhances storage stability.

Although ice cream is the focus of this project, the researchers anticipate that their findings could be used to improve the quality and shelf-life of other frozen foods without the use of additives.

Teaching the finer points of dairy delicacies

Guelph's Ice Cream Technology Course is an annual one-week intensive training course for personnel from the ice cream manufacturing, supply and

retail sectors. Food science professor Doug Goff has taught the technology-focused course for the past 10 years.

Each year, 30 to 40 people from across Canada -- and as far away as France, Italy, the Philippines and Barbados -- come to U of G for the course.

"Participants from the ice cream industry come to update themselves and to learn and improve their own knowledge," says Goff.

Participants are exposed to state-of-the-art processing and research, while building long-lasting relationships with fellow ice cream practitioners.

The course has been running at Guelph since 1914. Retired food science professor Sandy Pearson -- who taught the course from 1954 to 1984 -- will be honored June 21 with the dedication of the Pearson Room in the new Food Science Building. The room has been refurbished by the class of OAC 1963, of which Pearson was honorary class president.

HOME CONTENTS PREVIOUS NEXT

Enriched milk has new nutrient

by Polly Stanley


Christina Clark
Student research writer Polly Stanley looks forward to reaching for milk with a twist.

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

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

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

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

Despite the emphasis on reducing dietary fat intake in Canada, our bodies do need *some* fat. In particular, DHA -- an omega-3 polyunsaturated fatty acid (PUFA) -- is needed in the eye and brain for optimal visual performance and mental functioning.

And there's growing interest in the cardiovascular benefits of eating DHA-rich diets. Recent studies show that as DHA consumption increases, the risks of cardiovascular disease go down, possibly because of DHA's antiarrhythmic effect.

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

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

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

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

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

Fatty acids in plants are often polyunsaturated. The bovine digestive system changes fatty-acid structure from polyunsaturated to saturated through a process called biohydrogenation. Because LNA undergoes biohydrogenation, there is limited opportunity for conversion of LNA to DHA. As a result, cows' milk is devoid of DHA.

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

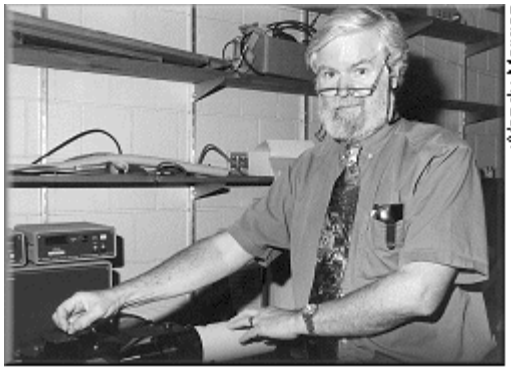
How does it work? Holub suggests that DHA in the feed is less susceptible to biohydrogenation than LNA and other PUFAs are. McBride and Wright also think that something about the formulation they've created inhibits biohydrogenation. That means LNA could pass through the gut unaltered and be converted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

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

HOME CONTENTS PREVIOUS NEXT

New uses for curds and whey

by Amina Ali


Wendy Morgan
Douglas Dalgleish is adjusting milk fat proteins to expand the uses of dairy materials.

A cold, refreshing glass of milk may seem like a simple beverage, but it's actually a highly complex liquid. A U of G researcher is unravelling the mysteries of milk so they may be applied to an ever-expanding variety of creamy foods and drinks.

Food science professor Doug Dalgleish is investigating how milk proteins such as caseins and whey proteins function as ingredients in other foods. His basic research is supported by the Ontario Dairy Council, a trade association of many major food companies that use milk or its components in the formulation of products. By understanding milk ingredients and what they do, these companies will be able to use milk ingredients more effectively.

Milk components have always served as effective emulsifiers and texturing agents in foods. But Dalgleish's research allows milk components to be used both in improving infant formulas and soups and in creating new products entering the market such as health/sports drinks. Its a win-win-win situation -- dairy producers will sell more milk, food processors can expand their product lines, and consumers will gain better textured and varied foods.

"The world dairy community should maximize the use of its materials," says Dalgleish. "Expanding the use of milk ingredients such as proteins is one way to use this nutritious product to its fullest."

He begins by extracting milk proteins and studying their interactions with other food components. His research aims to answer common questions posed by food processors. Is an emulsion -- a suspension of small oil droplets surrounded by milk proteins that provides a creamy flavor -- stable enough to be added to foods without causing an adverse reaction during storage? Will it remain stable during processing at low pH to reduce microbial contamination?

The food industry is eager to use milk ingredients as emulsifiers in processed foods. As interest mounts for new fruity health/sports drinks, the need for an emulsion to maintain the properties of the juice becomes clear. Milk proteins are among the best for the job because of their superior functional and nutritional properties. Dalgleish's job is to investigate the basic properties of milk proteins and how these properties can be altered.

"We are trying to understand these interactions at the molecular level," he says. "Studying the basic chemistry and physics of the system provides insight into milk, a complex liquid food."

This basic underpinning research offers an explanation for the value of emulsifiers,

especially for complicated liquid food products. Achieving this understanding will allow current food products to be improved and new ones to be made.

The Ontario Dairy Council's support for this research is matched by the Natural Sciences and Engineering Research Council. Several multinational food companies have also been involved.

Back to bacteria

Scientists use beneficial 'bugs' to promote health

by Amina Ali


Victor Wong
Beaded bacteria can add nutrients to dairy drinks, says Wenrong Sun.

Although almost everyone is trying to stomp out bacteria in the dairy industry, one group has targeted the benefits of "good" bacteria for consumers.

Prof. Mansel Griffiths and graduate student Stéphane Cadieux, Food Science, along with Guelph food scientist Yukio Kakuda and Owen Ward of the University of Waterloo, are trying to improve the nutritional value of dairy products by adding beneficial fatty acids made from bacteria.

They're looking at omega-3 fatty acids, important nutrients for nervous system and eyesight development in babies that may also prevent cardiovascular disease and cancer in adults.

The researchers are using bacteria to produce omega-3 fatty acids from whey, a waste product of dairy manufacturing that eventually ends up in the environment. They hope strains of the bacteria that produce high levels of omega-3 fatty acids could be used in their procedure to ultimately create a commercially viable process.

If successful, the plan would represent an inexpensive way to create omega-3 fatty acids to add to cows' milk.

"This research has two benefits -- a value-added product with increased nutrients and a reduced impact on the environment," says Griffiths.

Three forms of beneficial omega-3 fatty acids are alpha linolenic acid, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), and are produced by marine bacteria. Griffiths wants to add the genes responsible for synthesizing omega-3 fatty acids into lactic acid bacteria, which are used to produce fermented milk products.

As part of another project, Griffiths and graduate students Jane Ellenton and Wenrong Sun are collaborating with food scientist Linda Harris at the University of California, Davis. They're investigating more efficient ways to deliver beneficial bacteria to the gut of humans and animals.

It's been suggested that when certain bacteria such as *Bifidobacterium* colonize the gut, they protect against infection by foodborne pathogens and produce other positive health effects. The trick is to get them to sites where they can grow without being harmed by adverse conditions in the food or the stomach.

The approach used by Griffiths's team is modelled on a non-dairy beverage being targeted in the United States for teenagers. The drink consists of a fluid component containing gel beads (about the size of a pinhead) suspended within, to impart different flavors to the drink.

The bead suspension technique could be applied to dairy products for probiotics -- bacterial cultures with beneficial health properties. This involves using beads that protect the bacteria from the harsh acidic environment of human stomachs, so the nutrients can be delivered intact.

"We intend to use the beads to immobilize bacteria and tailor the system to a variety of dairy products, such as fermented beverages and cheeses," says Griffiths.

His team is determining the best conditions to promote survival of the bacteria in acidic environments. The bead delivery system itself uses a calcium salt to form the beads. An added bonus of the beads is that this may be an effective way of delivering calcium.

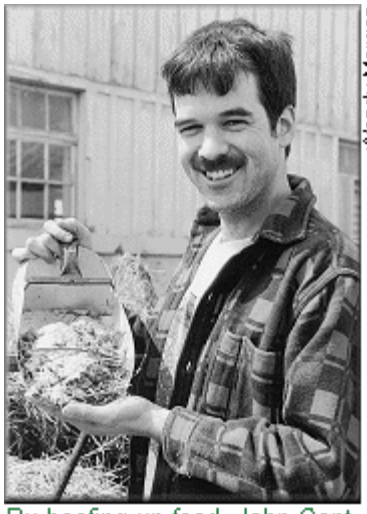
"The dairy industry will derive greater sales from its fermented dairy products," says Griffiths, "and consumers will gain more nutritionally complete food and drinks."

This research is supported by the Dairy Farmers of Ontario and the Natural Sciences and Engineering Research Council.

HOME CONTENTS PREVIOUS NEXT

Happiness is . . . less milk fat

by Amina Ali


Wendy Morgan
By beefing up feed, John Cant is lowering milk fat.

Reducing milk-fat production is sure to please health-conscious consumers -- and the airy industry -- says a U of G researcher.

Animal science professor John Cant believes that feeding dairy cows different fatty acids their diets can reduce the proportion of fat in their milk.

It's known that the "trans" form of fatty acids -- with hydrogens on opposite sides of a hemical bond -- depresses milk-fat production. Cant is studying how these trans fatty acids ause milk fat to be reduced and if changing dairy feeds will alter fat production.

"Dairy farmers want to sell more milk, but their sales are limited by excess fat in their product," says Cant. "That's why we're focusing on lowering milk fats using trans fatty acids."

Cant thinks lower milk fats are possible, thanks to the bacteria that reside in a cow's rumen. These bacteria break down in cow's feed and convert it into a form the cow can absorb.

During the degradation process, the polyunsaturated fatty acids sometimes become monounsaturated. It's the monounsaturated form that contains half trans fatty acids, which depress milk fat. How this process works is a matter of blood metabolism, which Cant and Prof. Don Trout, Clinical Studies, are studying.

Feeding studies are under way using partially hydrogenated vegetable oil, which contains trans fatty acids. These results will suggest how much needs to be fed to derive an optimal fatty-acid composition in the milk. But other researchers, both at Guelph and elsewhere, have found that a diet high in trans fatty acids can be detrimental to human health. So Cant is trying to strike a balance between using trans fatty acids to decrease fat production and hoping excess levels don't appear in cows' milk.

"Trans fatty acids make up a very small percentage of a cow's diet, but we'll be sure to check what levels appear in the milk during the feeding trials," says Cant.

The data from these studies will also provide a valuable test for mathematical models of fatty acids in milk that have already been developed.

"This work will allow farmers to be more efficient, nutritionally speaking, while meeting consumer demands for greater milk proteins and less fat," says Cant.

his research is supported by the Dairy Farmers of Canada and the Natural Sciences and Engineering Research Council.

Mellower yellow

The search is on for more spreadable butter

by Amina Ali


Martin Schwalbe

Art Hill wants butter to make a smooth transition from fridge to toast.

Trying to spread butter on your toast straight out of the fridge is frustrating, if not impossible. But if U of G researchers have their way, the exercise will soon be a mellow event.

Food science professors Art Hill and Alex Marangoni and doctoral student Derick Rousseau are using biological and chemical techniques to increase the spreadability of butter.

"We want people to take butter directly out of the fridge, spread it on a piece of bread and say: 'I can't believe it's not margarine,'" says Hill.

They've used three different strategies to achieve their goal. The first and simplest technique involves blending butter with vegetable oil, specifically Canadian-developed canola oil. With its high level of monounsaturated oleic fatty acid, it's a heart-healthy vegetable oil. The blends improve the spreadability of butter at cold temperatures and create a nutritionally superior value-added product.

That's great for people who store their butter in the fridge, but it doesn't work at room temperature. So the researchers are trying another approach called chemical interesterification. It involves chemically rearranging the fatty acids in butter in a random fashion. Although the technique works, it gives the transformed butter an odd fruit punch flavor, according to sensory taste panelists.

The researchers are also trying enzymatic interesterification, using enzymes -- proteins that speed up chemical reactions. The reaction conditions used in enzymatic interesterification are milder than those used in chemical interesterification, so the fragile nature and taste of butter are preserved.

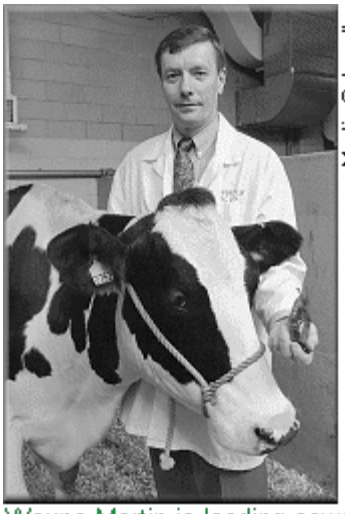
The researchers think there's a market abroad for Canadian butter, which could capitalize on Canada's image and the success of other export agri-food products such as wheat, pork, wine and maple syrup. They say improving the spreadability and nutritional properties of butter could make it a more valuable export commodity.

"A more spreadable butter is a value-added product that will boost the Canadian dairy industry," says Rousseau.

This research is sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs, and the Natural Sciences and Engineering Research Council.

Icing milk fever

by Amina Ali


Martin Schwalbe
Wayne Martin is leading cows to better recoveries.

Some private practitioners have found that supplementing cows with phosphorus appears to help them recover from "milk fever" -- a condition principally caused by a low calcium level, resulting in initial excitation and then weakness after calving.

Now, University of Guelph population medicine professors Wayne Martin and Ken Leslie are co-ordinating a field study to determine if phosphorus supplements can help the estimated 15 per cent of cows that don't respond to the usual calcium treatments for milk fever.

"The non-response rate is just too high, from both an animal-welfare and economic-loss point of view," says Martin.

Cows' calcium levels often fall after calving, as calcium in the blood is diverted to the udder. Calcium and phosphorus are tied together in metabolism, so supplementing with phosphorus may boost recovery from the low calcium conditions of milk fever.

As part of the study, the Ontario Association of Bovine Practitioners will be blood sampling up to 1,500 cows this summer. The 15 per cent of these cows that don't respond to the typical calcium treatment will then be randomly given either a phosphorus supplement or a placebo. Neither the veterinarians nor the farmers will know which cows are being given the phosphorus treatment.

All these precautions will make it easier for Martin and Leslie to see if there's a conclusive difference in recovery rates between those cows given phosphorus and those that are not. By taking blood samples at each stage, the researchers can test cows' calcium and phosphorus levels and study their metabolism, including liver function, more closely. By examining the cows' metabolic profiles, the researchers hope to get a handle on predicting which cows will recover from milk fever.

Martin and Leslie say the study has significant applicability because it's being done on farms. And if it's shown that phosphorus supplements work well, then they may bemay then be better able to predict which cows are more prone to the disease. If the treatment works, it begs for more detailed physiological studies to help understand why. In either case, the study will help farmers and vets prevent and treat the disease. It's hoped this will be a big step in the ongoing struggle to prevent death and improve cow health.

"It's a timely trial," says Martin. "Veterinarians need to know whether they should be using phosphorus and what positive and negative effects it has."

The Ontario Association of Bovine Practitioners is funding the trial. The phosphorus supplements are being supplied by Pfizer.

How to lick pain

by Sarah Haines


Van Dusen Stock Photography
A loving lick brings pain relief to Mom and comfort to her calf.

Cows know how to lick the pain associated with birth -- literally, say U of G researchers.

Carlos Pinheiro Machado, an animal and poultry science master's student, and Prof. Frank Hurnik believe the amniotic fluid cows ingest by licking newborn calves minimizes post-birthing pain.

The researchers say tests they performed at the Elora Research Station suggest there's a "placental opioid enhancement factor" in the fluid, meaning it has an analgesic effect similar to ASA.

"When it comes to pain management in cows, Mother Nature knows best," says Hurnik. "Licking appears to help them feel better."

The researchers conducted their year-long project with 36 dairy cows. The animals were divided into two groups -- those that had the opportunity to lick their calves (and ingest amniotic fluid) after giving birth and those that were distanced from their calves immediately following birth.

Both groups were exposed to heat lamp-like devices in their stalls. Researchers observed how long the animals remained comfortable with the heat the lamps gave off. They found the cows that licked their calves tolerated it longer, suggesting an elevated pain threshold.

"We believe that the analgesic effect of the amniotic fluid was responsible for this increase in pain threshold," says Hurnik. "We don't know the chemistry at work -- we need to work with a chemist to analyse the fluid's composition."

The researchers say licking has another benefit. During the first hours after birth, mothers' licking stimulates the calves' circulation and motivates them to stand up and seek nourishment. It also helps new mothers focus on protecting and nurturing their newborns because the distraction of post-natal pain is reduced.

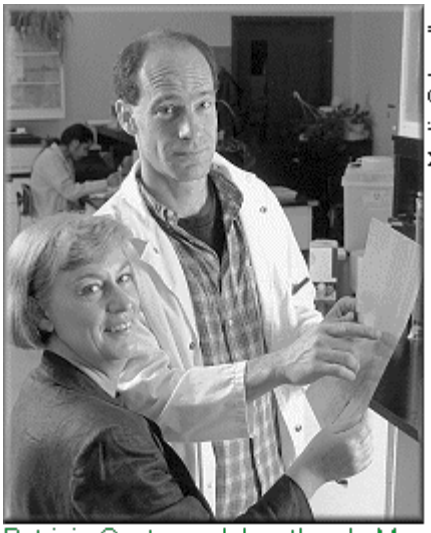
"This is valuable information for farmers," says Hurnik. "Understanding cows' behavior will help us improve the management of calving and consequently their well-being. We should try to understand these natural processes."

This research is sponsored in part by the Ontario Ministry of Agriculture, Food and Rural Affairs.

A big 'Factor' in dairy cow reproduction

Researchers make progress eliminating Factor XI disorder

by Sarah Haines


Martin Schwalbe

Patricia Gentry and Jonathan LaMarre are factoring out XI disorder.

Canada is making progress eliminating a biochemical genetic deficiency in Holstein cattle, through a testing and research program at U of G.

The deficiency is called Factor XI disorder. Factor XI is a blood protein that aids normal blood functions, including clotting. A deficiency in the protein sparks problems such as hemorrhaging, inflammatory diseases and reduced ovarian follicular development.

Testing for all of Canada is conducted by Prof. Patricia Gentry, Biomedical Sciences, and research technician Michelle Ross. Gentry's laboratory has established international standards for the biological test currently used to classify an animal as having either Factor XI deficiency or being a carrier.

The problems aren't always evident. Although carriers with about 50 per cent of normal Factor XI values can live normal lives, they may spread the defect through their progeny.

"Because there is no immediate, obvious physical defect like a deformity associated with it, Factor XI deficiency has tended to be dismissed," says Gentry. "But any condition that reduces the conception rate in Canadian dairy herds limits the profitability of milk and embryo production."

Factor XI deficiency was first reported in a dairy herd at Ohio State University in 1969. Gentry found it in Canada in 1975, in a lone steer named "George" that was part of the Ontario Veterinary College's research herd. George had some of the best Canadian Holstein bloodlines in his parentage, so the mode of inheritance and the potential incidence concerned OVC and the industry.

Gentry has been pursuing the problem ever since. Past research involved charting the pattern of inheritance. Now, she's focusing on the reproductive problems associated with Factor XI-deficient cows.

She and her collaborators have found that reduced fertility levels may result because ovulation occurs earlier and follicular diameter is smaller among Factor XI-deficient cows. Since 1994, her team in the Department of Biomedical Sciences has been working on a novel approach to investigating the physiological processes

in follicular development. Preliminary results have been extremely promising, she says.

With the use of cell culture studies and molecular probes developed in the laboratory of Gentry's colleague Prof. Jonathan LaMarre, it has been shown that Factor XI may be involved in thrombin formation in the ovarian follicle. Thrombin acts as a growth promoter in cells isolated from pre-ovulatory follicles; its absence may be responsible for reduced follicular development.

Although it's still too early to predict whether there is a direct association, Gentry hopes that an increased understanding of the normal control mechanisms involved in follicular development will enable researchers to develop intervention strategies to treat some fertility problems.

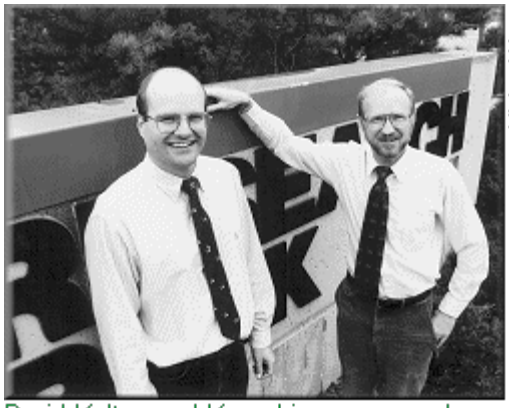
"An examination of this defect has the potential to increase the reproductive efficiency of Holstein cows," she says. "This will ultimately translate into increased economic returns for the dairy industry."

Gentry is also involved in a collaborative effort with researchers at the University of Illinois and the Elizabeth Macarthur Agricultural Institute in New South Wales, Australia, to develop a genetic test for Factor XI deficiency. A DNA test has been developed for the human form of the disorder, but has proved unsuitable in cattle, partly because the gene for Factor XI is on a different chromosome in humans and Holsteins.

"Each time our studies of Factor XI are about to come to an end, a new finding sparks renewed interest in this deficiency," she says. "Over the years, this research has really become interdisciplinary."

Straight to the source

by Amina Ali


Victor Wong

David Kelton and Kerry Lissemore work with producers and industry, managing on-farm decisions.

Canada lacks a comprehensive national database for collecting information on dairy farm health and production. But U of G researchers are working with dairy industry partners to develop an information system that will support producers' management decisions.

Population medicine professors Kerry Lissemore and David Kelton have several research projects on the go that they call collectively "A Decision Support System for the Ontario Dairy Industry." As part of this overall scheme, they are developing guidelines and national standards for dairy cattle disease recording and presentation. These guidelinesstrong> will help researchers investigate the genetic component of disease, compare disease occurrence nationally and internationally, and modify management practices to promote animal health.

"One of our goals is to combine biological information with financial data," says Lissemore. "Ultimately, the goal of dairy producers is to preserve the health of their herds and increase their enterprise profitability. Understanding the interrelationship between the biology of the dairy herd and the economics of the farm business allows us to help dairy producers reach that goal."

Lissemore and Kelton are developing techniques to integrate these seemingly disparate areas. But their work isn't done in a usual laboratory setting -- instead, Ontario dairy herds are their data source. It's the way to get the high-quality production, disease and financial data they need.

The system is being developed in conjunction with the dairy industry. In fact, it's organizations such as the Ontario Dairy Herd Improvement Corporation (Ontario DHI) and Promark Technologies that are contributing the tangible resources, while Lissemore and Kelton are providing their advice and expertise.

In response to increasing global trade opportunities and reduced government funding, the Canadian dairy industry is undergoing many changes. The researchers saw this as an opportunity to develop mutually beneficial partnerships. The University gains affordable access to valuable data for research purposes, while the industry gains insight and analysis.

Kelton and Lissemore are working on a related project to complement their decision support system research. They're working with industry partners to develop a "sentinel herd network" -- co-operator dairy herds that are willing to participate in more comprehensive data collection -- so they can keep their fingers on the pulse of Ontario's dairy herd health status and productivity.

The sentinel herds are a network of dairy farmers and their herd veterinarians, working with the Dairy Farmers of Ontario (DFO), the Ontario Association of Bovine Practitioners (OABP), Ontario DHI, U of G and the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA). Although this effort will focus initially on udder health and milk quality, it may eventually serve as a model for a national dairy health surveillance system.

The sentinel herd network provides several significant benefits:

- a perspective on the current health status of Ontario dairy herds -- an important factor for world trade purposes;
- the opportunity to identify and document changes in health status over time; and
- a mechanism to provide more detailed information for the decision support system.

"The decision support system and sentinel herd network will provide new competitive knowledge to today's global market," says Kelton. "We anticipate that veterinary practitioners will play a key role in the delivery of this new information to their dairy producer clients."

Financial support for this research is provided by the Grow Ontario Investment program and OMAFRA. Industrial funding and in-kind support are provided by Ontario DHI, the DFO and the OABP.

'Preventive genetics' for healthier Holsteins

by Jeff Stuart

Healthier Holsteins could be the products of "preventive genetics," a breeding system being developed by U of G researchers to enhance the immune response and disease resistance of dairy cows.

Prof. Bonnie Mallard, Pathobiology, is developing a selective breeding system that holds promise for providing healthier cows that can produce more milk of higher quality. Mallard, along with fellow pathobiology professors Bruce Wilkie and the late Bri an Kennedy, has already shown the benefits of breeding for better health in pigs.

The researchers have designed a program that uses blood and skin tests to measure the immune responses of young pigs. Those animals with enhanced immune function were bred, and the results have proved rewarding. The healthier pigs grow faster and reach market weight more quickly.

"We have shown with pigs that it is possible to select for health-related traits," says Mallard. "It may be that the high-immune-response pigs are healthier and can therefore devote more energy to growing."

Healthier animals also require fewer antibiotics, an important consideration for farmers wishing to market their products to increasingly health-conscious consumers.

Mallard is trying to bring these strategies that have worked with pigs to the dairy industry. She and M.Sc. student Laurie Wagter are testing the same skin and blood parameters developed for pigs to identify high-immune-response cows, with promising e arly results. Now they are trying to take this one step further by identifying the genes responsible for enhanced immune response or disease resistance.

Mallard and PhD student Shayan Sharif are studying a family of genes called the major histocompatability complex (MHC). These genes are responsible for making critical proteins involved in the immune response. They have identified one 'bad' gene that a ppears to be associated with an increased incidence of mastitis, an inflammation of the mammary glands in dairy cows that causes a reduction in milk quantity and quality and results in significant losses to dairy producers.

Mallard is now trying to determine if the genetic marker is associated with impaired immune function. It may also be possible to identify genes that are responsible for enhanced immune response. Eventually, good and bad genes (like the one they've alre ady found) may be identified in young calves, permitting a more informed selection of animals for further breeding.

In time, information on the different immune responses and the presence of specific MHC genes may be pooled to give an "estimated breeding value," which provides an indication of overall Holstein health.

"As we learn more about what makes dairy cattle healthier," says Mallard, "we can make increasingly more informed choices in the breeding process, so that we can consistently identify the healthier animals. We believe this will increase herd production and reduce the cost of looking after the cows. When viewed across the entire industry, the financial gains of these improvements could be quite significant."

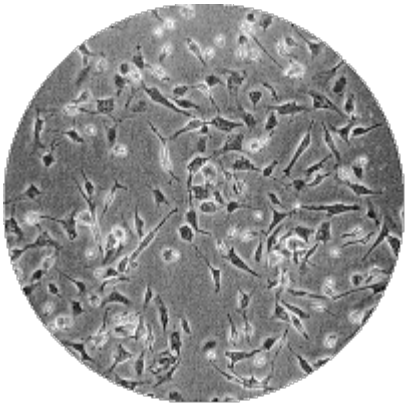
This research is sponsored by the Natural Sciences and Engineering Research Council, the Ontario Ministry of Agriculture, Food and Rural Affairs and SEMEX.

HOME CONTENTS PREVIOUS NEXT

Furthering follicle fortunes

Researchers unlock key factors affecting pre-fertilization ovarian cell growth

by Amina Ali



Bovine ovarian follicle cells in culture, 12 hours after removal from the ovary.

Some key factors affecting the growth of ovarian cells before fertilization -- and limiting reproductive technologies for the dairy industry -- are being unlocked by U of G researchers.

Biomedical science professors Jonathan LaMarre and Patricia Gentry are identifying several components of the growth of ovarian follicles -- the small structures in the ovary made up of the egg and surrounding "nursemaid" cells.

"In spite of many recent advances, follicle failure continues to be one of the factors limiting bovine reproductive success," says LaMarre. "Enhancing the reproductive success of cows suited to milk production would accelerate the development of high-producing herds."

Normally, a cow ovulates a single oocyte (egg) once every 28 days. With hormone therapy, the number of oocytes could potentially be increased up to 20 fold. But the potential can't be consistently realized until more is understood about the biology and technology of the process. What restricts the technique is not understood, but LaMarre and Gentry are suggesting some possibilities.

Follicular growth can fail in several ways. In a process known as atresia, several follicles may never make it to their destination, and only one follicle survives. Or the follicle may be "ready to roll," but a follicular cyst prevents its release. Follicular cysts are double trouble -- not only is the follicle prevented from entering the cycle, but a cow is also generally infertile while cysts are present.

LaMarre and Gentry suspect that proteinases -- enzymes regulating the growth of the nursemaid cells surrounding the follicle -- may be prevented from carrying out their job in these disorders. A clotting factor called thrombin is a potent stimulator of growth and hormone production by nursemaid cells. Relative deficiencies in the amount or activity of this enzyme may impair follicular growth and decrease fertility. Because these enzymes work in "cascades," the researchers are also examining the role of other clotting factors and proteins in the control of follicular development.

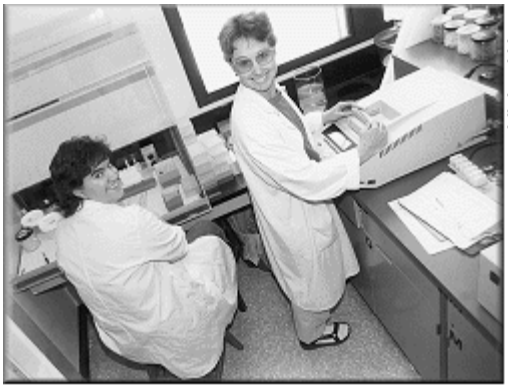
The follicles used in their studies are collected from cows at slaughter. After the follicular fluid is collected, it is categorized by size and analysed for clotting factor expression. Then the cells are cultured with the specific enzymes to see what effect these factors have on the growth of follicles or individual cells.

"We want a more rapid way to select for traits in our farm animals," says LaMarre. "Enhancing dairy cows' fertility increases profits and leads to a more rapid improvement of genetic quality. Furthermore, these studies help us understand basic aspects of reproductive biology in many species."

This research is sponsored by the Natural Sciences and Engineering Research Council and the Ontario Ministry of Agriculture, Food and Rural Affairs.

Fine-tuning technology

by Jenny Tye


Victor Wong

Kathryn McDougall (seated) and Ann Hahnel are improving reproductive technologies.

Minimizing early embryo damage at the gene-expression level is the best way to increase the success of current reproductive technologies, say U of G researchers.

PhD student Kathyrn McDougall, Prof. Ann Hahnel and summer trainee James Beecroft have developed a marker to help characterize the normal expression pattern of a particular gene in the pre-attachment bovine embryo.

McDougall is now using this marker to determine what particular manipulation techniques and reagents have negative effects on the embryo's processing of genetic material.

"The dairy industry relies heavily on reproductive technologies and is constantly demanding more fine-tuning in this area," says Hahnel. "For fine-tuning, there's no better place to start than where small changes make a big difference -- at the molecular level."

Damage to gene-processing "machinery" can result in embryo death during development. As a result, the cause of the damage is difficult to pinpoint. Hahnel's work is the first step towards improving delivery of these technologies down the line.

She says her team's work will help determine when and how even minimal damage occurs during embryo manipulation.

McDougall is specifically studying the pre-attachment stage between egg fertilization and embryo attachment to the uterus wall. This is the stage where embryos are usually handled -- and when most embryonic death occurs. She's using her knowledge about the gene expression of a specific group of enzymes found on the surface of bovine embryos to help her in her study.

These enzymes, the alkaline phosphatases, are expressed on the embryo's surface in different amounts and forms during early, mid- and late pre-attachment stages. Although McDougall doesn't know the function of these enzymes, she says if her team can detect when the expression pattern of these enzymes is altered, they'll have a good indicator of when genetic damage has occurred in the embryo.

The researchers have already developed the tools they need to study enzyme activity. Now they can begin looking at the effects of different technologies on the synthesis of these enzymes from genes.

They're comparing the enzyme's expression pattern in normal and manipulated

pre-attachment embryos after various techniques. They've already found that a drug used to facilitate nuclear transfer (a manipulation technique) alters the expression of alkaline phosphatases.

"If this drug can alter the expression of the gene we're studying, then it's very possible that the expression of other, more life-essential genes are at risk from damage by the same chemical," says Hahnel. "This is the type of information we want to know for all reproductive manipulations."

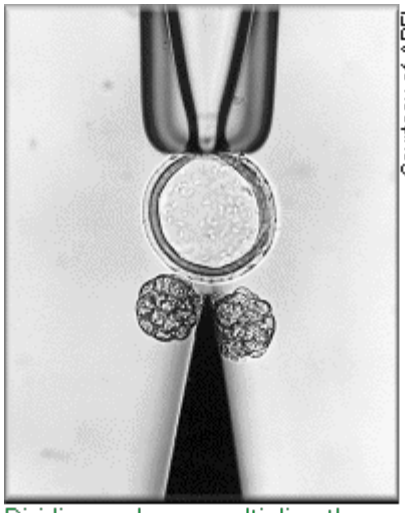
This research is sponsored by the Ontario Ministry of Agriculture, Food and Rural Affairs. Beecroft is working under a sponsorship from the Natural Sciences and Engineering Research Council.

HOME CONTENTS PREVIOUS NEXT

The roots of dairy genetics

Researchers bring forward practical and economical knowledge

by Polly Stanley


Courtesy of ABEL
Dividing embryos multiplies the success of embryo technologies.

U of G researchers mean business -- BIG business -- when it comes to enhancing Ontario dairy genetics.

The university is home to an unparalleled team of geneticists and reproductive biologists who have played an integral role in improving Ontario dairy genetics. Together, they're applying knowledge in a way that's practical and economical. Their success is borne out by Canada's respected position in the global dairy genetics market.

"That's the real value of work in embryo biotechnology," says Dr. Donald Rieger of the Animal Biotechnology Embryo Laboratory (ABEL). "The techniques are making it into the business world and keeping the Canadian dairy industry well situated to respond to changes in genetic requirements."

ABEL is dedicated to making procedures less complicated and more available to Canadian producers. The laboratory was launched by embryologist and reproductive biologist Prof. Keith Betteridge through a major Natural Sciences and Engineering Research Council research chair program. ABEL now consists of 15 personnel under the directi on of Prof. Stanley Leibo.

ABEL researchers are all working towards the same goal -- increasing the intensity and accuracy of genetic selection while decreasing the generation interval of dairy cattle. They're doing this by perfecting a variety of techniques for use in dairy her ds.

Since the 1950s, semen from elite bulls has been used for artificial insemination (AI), a technology that has become the backbone of dairy cattle improvement programs. It has resulted in a dramatic increase in the intensity of the gene pool for dairy b reeding.

"Artificial insemination is now -- and will remain -- the most important breeding technique for genetic improvement," says Rieger.

Multiple ovulation and embryo transfer (MOET) was developed in the 1970s. Like AI, this technology has played a leading role in distributing the genes of the very best animals. MOET involves treating a genetically superior cow with hormones that stimu late her to produce many embryos at a time. The embryos are collected and transferred into a recipient female. This way, a good donor cow can produce 30 to 60 calves a year instead of just one.

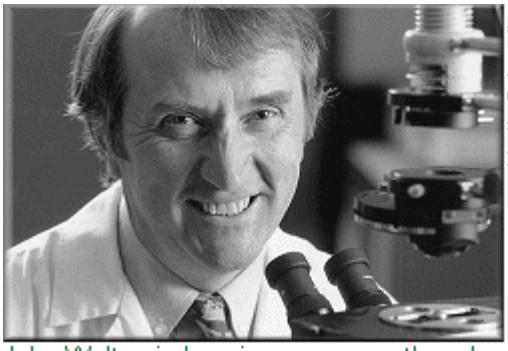
In vitro production (IVP) of embryos differs from MOET in that unfertilized oocytes (eggs) -- rather than embryos -- are collected, then fertilized and matured in the lab. This means embryos can be produced from otherwise infertile, yet valuab le cows. In addition, because eggs can be collected from sexually immature heifers, the generation interval can be significantly reduced.

Another research avenue that stems from IVP is embryo manipulation. IVP -- in contrast to MOET -- gives researchers access to embryos before significant cell division has occurred. At this stage, the embryos can be split to produce groups of identical calves, a technique that will have a significant impact on the industry in future.

"These techniques are now at or near the point of practical application," says Rieger. "Fortunately, here in Canada we have the expertise, the infrastructure and a history of willingness to implement new techniques for genetic improvement."

HOME CONTENTS PREVIOUS NEXT

Faster-growing embryos yield more pregnancies


Martin Schwalbe

John Walton is keeping an eye on the role of hormones in dairy cow pregnancy.

by Jeff Stuart

Embryonic mortality, a major stumbling block limiting the reproductive potential of dairy cattle may no longer be such a hurdle, thanks to U of G research.

For dairy farmers, profits bank on maximizing the output of their milking herd. Selective breeding using artificial insemination with semen from top bulls is dramatically increasing herd productivity. But artificial insemination is limited by the reduced viability of embryos developed from eggs (oocytes) fertilized with previously frozen sperm. Their retarded early growth means that fewer of these embryos develop to term than do those from normally fertilized eggs.

"By helping these slower developing embryos to grow more quickly," says animal science professor John Walton, "we can reduce embryonic mortality, increase the number of pregnancies and enhance productivity."

Timing is critical. Herd productivity hinges on establishing a new pregnancy early in the lactation cycle, so the cow finishes lactating while pregnant and then calves, to initiate a new cycle of lactation. To maximize milk production, cows need to be inseminated after two months of lactation. But, the embryos fertilized with previously frozen sperm sometimes have trouble keeping up with the pace of their mother's hormonal changes. As a result, some of these embryos don't start making their own hormones on cue.

This can lead to embryo death, if the signal to continue the pregnancy -- a hormone called interferon -- isn't sent from the embryo to the mother at the appropriate time, around 16 days after insemination. The balance of back and forth signalling between mother and embryo is upset. The cow doesn't recognize the pregnancy, so a new estrous cycle is initiated and the embryo is lost.

Together with graduate student Tracey Kerbler, Walton is trying to speed up the growth of embryos, so that interferon can be produced in sufficient quantities, and at an early enough stage in the pregnancy, to maximize the chances of the pregnancy continuing. He is focusing on the uterus (the environment where the embryo develops), and trying to make it more hospitable to embryo growth.

He has found that a single injection of a commercially available hormone, called chorionic gonadotropin (CG), five days after insemination stimulates development of a corpeus luteum (a glandular tissue that produces progesterone) in the ovary.

With a single application of a very low dose of CG, the cow increases its own production of progesterone by 15 to 20 per cent, not only during the critical period of pregnancy recognition, but also throughout the pregnancy. Progesterone, the

pregnancy hormone, causes favorable changes in the uterus to promote embryo growth and synthesis of interferon.The treatment minimizes interference to the cows, and provides an inexpensive and simple means of enhancing productivity.

"The great advantage of this approach", says Walton, "is that it involves a single, inexpensive and relatively non-invasive treatment, and provides a persistent beneficial effect in supporting pregnancy."

This research is supported by the Natural Sciences and Engineering Research Council and the Ontario Ministry of Agriculture, Food and Rural Affairs.

HOME CONTENTS PREVIOUS