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Inside:

Meat Under the Microscope

With annual sales of 10.9 billion dollars, the meat processing industry is the largest sector of the food industry in Canada. In addition, the value of red meat exports is $ 3.1 billion. Unfortunately, foodborne illness costs Canada $1.1 billion annually and red meats are the major vector of pathogens among all foods.

Meat safety has become a global priority and importers of meats in lucrative Pacific Rim and US markets have become very selective.

The consumer has become increasingly aware of food safety issues and the economic and personal devastation of meat associated illness.

The Lacombe Research Centre is ideally situated to tackle meat safety issues. It has its own beef and swine herd and a CFIA-inspected slaughter and meat processing facility.

A new laboratory complex allows 5 research scientists and 9 technicians to conduct comprehensive research in response to meat saftey issues.

The Centre is close to a number of commercial abattoirs and processing plants where it is able to conduct studies under "industrial conditions". Its proximity to the University of Alberta allows collaborative work and co-supervision of graduate students.

Meat microbiology research at Lacombe focuses on two major areas.

1) Prevention of bacterial contamination of meat.

2) Development of strategies to understand and manage meat that is contaminated with bacteria.

The types of projects undertaken to prevent bacterial contamination of meat include:

- Identification of operations in commercial meat plants where meat may be at risk of contamination by bacteria such as *E. coli*. This may lead to recommendations for modifications to equipment or procedures (i.e. cleaning, handling) that will improve the product's safety.

- This research is done both in the Centre's abattoir and commercial settings where the information may contribute to Hazard Analysis: Critical Control Point (HACCP) systems.

Strategies to improve the safety of meat include:

- Monitoring the temperature of meat while it is initially chilled, during storage, transport and retail display (cold-chain) to assess the impact on microbial growth and meat safety.

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Point of Interest

Escherichia coli is a normal inhabitant of animal and human intestines. Normally it supresses the growth of harmful bacteria.

A minority of *E.coli* strains cause human illness. O157:H7 is a rare *E. coli* serotype that produces one or more toxins that cause damage to the lining of the intestine. This can result in severe cramping and diarrhea or in more acute cases hemorrahagic colitis and other complications.

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- Evaluation of physical decontamination methods such as pasteurization.

- Harnessing the natural microbial population on meat to control undersirable organisms. This is accomplished by developing model systems under laboratory conditions and translating the results to commercial meat.

- Seeking ways to make meat-contaminating bacteria more sensitive to control treatments.

- Developing and evaluating innovative packaging processes to increase storage life and aid meat distribution both nationally and internationally.

Key to achieving research objectives is the continual development and use of improved methods to identify, enumerate and characterize meat-borne bacteria.

Research at Lacombe offers regulatory authorities a means of setting and verifying stringent microbiological standards for assurance of meat safety which improves the competitiveness of Canadian meat products in domestic export markets.

Restoring consumer confidence in the safety of meat is a primary goal of the Meat Microbiology Team at Lacombe.

Growth of Cold-Tolerant Pathogens on Meat

Pathogens associated with raw, chilled meats originate in the live animal and contaminated processing equipment. These organisms may grow during the distribution, storage and retail display of meat. They may attain sufficient numbers to pose a risk to human health.

Temperature is the critical, environmental factor influencing the rate of bacterial growth. Although the mesophilic pathogens (eg. *Escherichia coli* 0157: H7) do not grow below 7°C there are a group of psychrotrophic or cold tolerant pathogens that can grow at 0°C or below (eg. *Listeria monocytogenes, Yersinia enterocolitica*). These pathogens are found on meat processing equipment, carcasses and meat cuts and are associated with outbreaks of meat-borne illness. Knowledge of the behavior of these pathogens at the temperatures experienced by meat during the distribution is critical to developing control measures.

Research was designed to determine the growth of *Y. entrocolitica* and *L. monocytogenes* on pork and fat and lean tissue and to validate models for predicting the growth of these pathogens.

The data in Table 1 show that both bacteria grew better on pork fat than lean. Thus, *L. monocytogenes* began growth on fat at temperatures between 0 and 2°C but did not grow on lean until temperatures were increased to 10-15°C. In a similar fashion, *Y. enterocolitica* could grow on pork fat at storage temperatures as low as –2°C but could not initiate growth on lean tissue until temperatures reached 6 to 8°C.

Most models used to predict the growth of pathogens in meats are based on data from commercial broths. The present research allowed comparison of predicted growth with that measured on inoculated fat and lean surfaces.

The results showed that current models tend to underestimate growth on fat tissue and overestimate growth on lean. Since these models misrepresent the growth of *L. monocytogenes* and *Y. enterocolitica* they cannot be applied as reliable predictors of meat safety at chill temperatures.

Written by Gordon Greer. Further information can be found in Food Microbiology 1995 Volume 12, Pages 463-469 & in the International Journal of Food Microbiology 1997 Volume 35, Pages 67-74.

Table 1. Effect of temperature on pathogen growth on raw pork

	Growth			
	L. monocytogenes		*Y. enterocolitica*	
Temperature (°C)	Fat	Lean	Fat	Lean
-2	-	-	+	-
-1	-	-	++	-
0	±	-	++	-
2	+	-	+++	-
4	++	-	+++	-
6	+++	-	++++	±
8	++++	-	++++	+
10	++++	±	+++++	++
15	+++++	++	+++++	+++

- no growth; + slight growth; +++++ abundant growth

Effects of Feed Withdrawl on E.coli *Numbers in Pigs*

Pork processors often require that pigs are held without feed before they are shipped to packing plants where they are held for a various times before slaughter. As a result of holding without feed, the contents of the gastro-intestinal tract are reduced and the pigs are easier to eviscerate. There is then less chance of the stomach and intestines being nicked with the release of contents on to the meat.

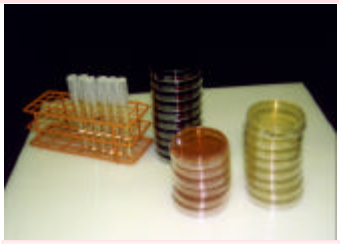
Withdrawal of feed undoubtedly causes stress to the animals with an accompanying upset of the balance of the normal flora of the gut and a potential change from innocuous intestinal bacteria to potentially pathogenic organisms. For better understanding of the effects of feed withdrawal on the gut flora, and its implications for food safety, *E. coli* in the stomachs and caeca of one hundred and fifty pigs subjected to different times of feed withdrawal before and after transport to the abattoir were enumerated.

Numbers of *E. coli* in the stomach were reduced as a result of feed withdrawal, probably due to increased acidity in the stomach. In the caecum, however, numbers of *E. coli* increased approximately 1.5 log units in pigs with a total time of feed withdrawal of 24 hours when compared to pigs which were fed until they were transported to the abattoir.

A small reduction in potential for pathogen carriage may be realized by allowing pigs access to feed until their departure for the abattoir followed by a short holding time at the abattoir before slaughter, instead of restricting feed intake overnight prior to slaughter.

If numbers of *E. coli* were the only consideration, no feed withdrawal before transport and a minimal abattoir lairage would be the best treatment. Implications regarding gut fill and the associated difficulties in processing would likely outweigh the microbiological benefits of not withdrawing feed until near the time of slaughter.

Written by Frances Nattress. Further information can be found in the Journal of Food Protection 2000 Volume 63, Pages 1253-1257.



Bacteria are frequently identified in the laboratory from their physical properties or how they grow (or don't grow) under certain conditions.

Bacteria can be separated by their basic shape: spherical (cocci), rod-shaped (bacilli), or corkscrew-shaped (spirochetes) and whether they move (motile) or not (non-motile).

They can also be classified as being Gram-negative or Gram-positive according to the composition of their cell walls and how they react with a Gram stain.

Whether bacteria require oxygen to survive (aerobic) or can live without oxygen (anaerobic) is another factor that may be examined.

The colour and shape of the bacterial colony on solid medium may also provide some clue as to the kind of bacteria.

Confirmation of both genus and species usually requires more specific testing.

Decontamination of Raw Meat

The USDA has promulgated microbiological standards for carcasses, ground beef and ready to eat meats. Attention has initially focused mainly on the microbiological condition of carcasses in general, and beef carcasses in particular. As many Canadian beef packing plants export product to the U.S., most have implemented decontaminating treatments for carcass in an effort to meet the U.S. standards. Although all the decontaminating treatments that are

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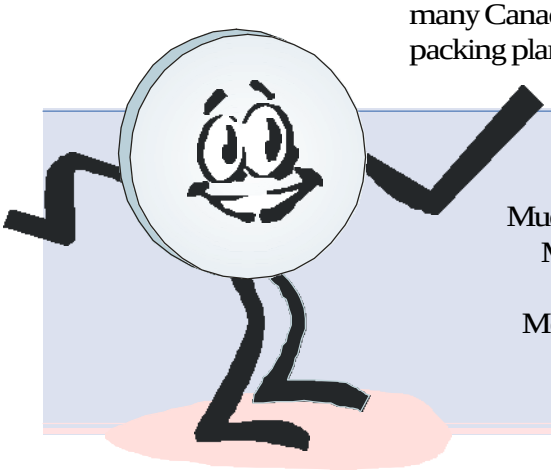

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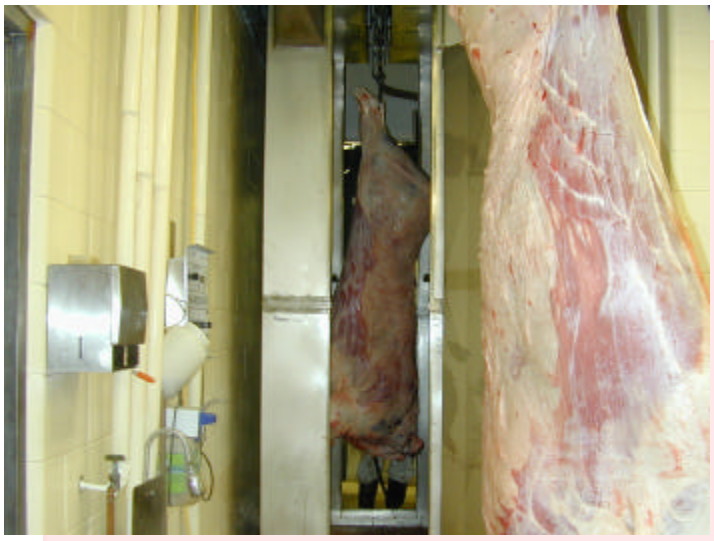
currently being used have been examined under laboratory conditions, there have been few studies of the results achieved in beef packing plants. Therefore, workers from Lacombe have examined the effects of decontaminating treatments which are applied routinely in commercial processes.

Those studies have shown that trimming, vacuum cleaning, vacuuming while applying hot water and/or steam, and washing are all generally ineffective for removing bacteria from carcasses. Treatment of carcasses with steam at above atmospheric pressure, or with sheets of water at 85°C using apparatus developed at Lacombe, are both effective. Treatment with steam at atmospheric pressure, washing with sprays of hot water and applying a solution of lactic acid, all of which are now common practices, are yet to be examined.

In the course of those studies it became apparent that the bacteria found on cuts and manufacturing beef, including most *E. coli*, are deposited on the meat during carcass breaking rather than carcass dressing. Thus, decontamination of carcasses, even when it is effective, cannot assure the microbiological safety of meat. Therefore, equipment for pasteurizing manufacturing meat is being developed by Lacombe staff in co-operation with commercial partners.

The work has shown that the numbers of *E. coli* on commercial product can be reduced to undetectable levels, and that hamburger patties formed from pasteurized product cannot be distinguished from ordinary patties. Means of proceeding to the installation of full scale equipment at a commercial plant are currently being considered.

Written by Colin Gill. Further information can be found in the Journal of Food Protection 1999 Volume 62, Pages 637-643 and the International Journal of Food Microbiology 1999 Volume 46, Pages 1-8.



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