
High Fiber, Beef, Humans, Stomach Acidity and Pathogenic *Escherichia coli*

Objective:

The purpose of this lesson is to show that high-fiber meals for beef cattle may reduce pathogenic *E. coli* that cause foodborne illness.

The Big Picture:

On the positive side, cattle finished on low fiber, starch rich grains (like corn), gain weight quickly and produce tasty marbled beef. However, on the negative side, they also may increase the acid resistant pathogenic *E. coli* that can be harmful to humans. The acid resistant pathogenic *E. coli* may survive the gastric acidity and cause infection and severe foodborne illness.

The lesson:

Safety of beef and beef products has made the news due to Mad Cow disease and *E. coli* O157:H7 contamination of beef products. The Mad Cow disease has been linked to feeding the ruminant animals (cattle) with feed containing rendered ruminant materials. While the United States is free of Mad Cow disease, U.S. Food and Drug Administration has taken measures to prevent the Mad Cow disease in U. S. cattle.

The Food Safety and Inspection Service of the U. S. Department of Agriculture, the agency charged with ensuring safety of meat and poultry supply in the U. S. is implementing measures to prevent *E. coli* O157:H7 tainted beef are occurring at beef processors. Beef processors must take care to avoid beef coming into contact with cattle feces and other contaminants during cattle slaughter and processing. In the kitchen, uncooked beef must be kept isolated from other foods to prevent the spread of *E. coli* O157:H7. In addition, beef must be cooked to a high enough temperature to kill any *E. coli* O157:H7 that may be present. If the above are strictly followed, illness can be prevented in humans.

A study at Cornell University by James Russell and Jennifer Rychlik, suggests that changing cattle diets could help prevent *E. coli* O157:H7 tainted beef. The study suggests that contemporary low fiber, high starch cattle grain diets promote pathogenic bacteria that are harmful to both cattle and humans. However, the results of this study have not been observed in other similar studies, indicating this may not be completely true.

Cattle are natural grass feeders and have developed a symbiotic relationship with a multitude of microorganisms that produce enzymes to digest fibery grasses into proteins, vitamins and fatty acids. Cattle also harbor a minority population of fermenting bacteria that thrive on starch rich grains. When cattle are finished fed on corn, the fermenting bacteria thrive and take over the rumen.

Fermenting bacteria produce lactic acid, which lowers the pH of the rumen and gut. The more acidic environment kills the healthy normal acid intolerant organisms and promotes the growth of abnormal acid tolerant organism, such as acid tolerant (surviving) *E. coli* O157:H7.

Generally, the *E. coli* that inhabit the guts of warm-blooded animals including humans, are harmless and good. Non-pathogenic *E. coli* help us digest food and dominate rich habitat that could be occupied by harmful organisms. However, there are certain types of *E. coli* that are pathogenic to humans and cause a variety of illnesses. An example for such type of *E. coli* is Enterohemorrhagic *E. coli* O157:H7. This organism has been traditionally isolated from food products such as ground beef, but recently, other products such as sprouts and fruits (watermelons, cantaloupes and apples) have been identified as sources of contamination.

When natural healthy conditions change (such as lowering the pH of the rumen) the normal *E. coli* give way to the abnormal bacteria, which may be harmful. In cattle, the highly acidic environment destroys the protective slime of the rumen lining. When the protective slime is gone, the harmful acid loving bacteria can migrate into the animal's blood stream and cause liver disease.

In humans, the normal stomach has a pH of 2, which is highly acidic. The acid environment kills most pathogens. However, if the pathogen is acid tolerant, the stomach does not produce enough acidity or the person is taking antacid tablets, the harmful organism can slip past the stomach acid barrier and cause disease. In humans, pathogenic *E. coli* can cause intestinal bleeding, severe diarrhea and kidney failure.

It is reasonable to assume that changing cattle diets from high-energy corn grain back to high fiber grass is not going to be popular with corn growers, cattle feeders or marbled-beef lovers. It is also reasonable to assume that people with sour upset stomachs will not stop taking antacid tablets.

In any case, modifying cattle feeding practices and the proper treatment of upset stomachs will not totally stop the problems of pathogenic *E. coli* in humans. More will have to be done. Additional food science research is needed to increase our knowledge, understanding, and wisdom to prevent *E. coli* O157:H7 foodborne illness. Knowledge and understanding are steps to wiser ways of doing things, like producing and consuming healthier food products.

It is estimated that some 25 million beef cattle die each year from grain feeding problems. Currently, thousands of Americans suffer from *E. coli* O157:H7 induced illnesses each year. What can we as individuals do? Keep raw uncooked beef and its products away from other foods and be sure that our beef is cooked to the proper *E. coli* killing temperature (160°F for hamburger). In addition, we need to support reasonable efforts to control food contamination problems before they reach the market place.

Activities syllabus:

Day one:

- I) Lecture and note taking.
- II) Assign diagram and written discussion question:
 - a) A full-page diagram that contrasts and compares the bovine and human digestive tracks.
 - b) A 100-word discussion paper, written to compare and contrast high fiber diets for humans and cattle.

Day two:

- I) Discuss and share individual diagrams and discussion papers in a group(s). Each group will report a consensus of opinions.
- II) Test, group or individual.