UtahState University COOPERATIVE EXTENSION

PRODUCER FACT SHEET BMP Best Management Practices

Pathogens in Animal Waste

What's the concern?

In production agriculture, animal waste is more than just a chore that needs to be managed, it is also a valuable commodity and supplement for fertilizer. The current rise in concentrated animal production and processing facilities has not only increased the efficiency of food production but also increased the total amount of animal waste in those areaa. This has also raised concern about food-borne pathogens that may be spread in the manure. Naturally, animal waste contains a plethora of microorganisms, both harmful and benefical. Some of those microorganisms, are hazardous and can be transferred to humans.

Pathogens

Although animal waste contains innumerous amounts of microorganisms, relatively very few are hazardous to our health. The majority of the organisms are either beneficial or neutral to higher organisms. However, there are several pathogens found in manure that, if not treated properly, can be detrimental when contained in food. It is important to note that restaurants and households are primarily responsible for safe-food handling practices; even if a food product is contaminated, proper washing and high-heat cooking before eating will prevent the vast majority of food-borne pathogen illnesses. The most prevalent pathogens are addressed below.

E. coli (Escherichia Coli)

E. coli is a naturally occurring bacteria found in mammal digestive systems; its ironically few harmful strains have made it one of the most famous food-borne pathogens today. The bacterium is capable of surviving and producing verotoxins for up to 10 weeks. It is hard to kill and known to reproduce in bovine manure in temperatures from 22° to 37° C. The most readily *E. coli* contaminated foods are meat products that inadvertently come in contact with animal manure during processing; more commonly the carcass and primal cut exteriors. The contaminated exterior is usually cut off of the retail cuts, but is often added into the hamburger grinder. Hamburger is required to be tested for *E. coli* contamination. If a contaminated portion of the carcass comes in contact with other retail cuts or processing equipment it can transfer the pathogen to other food products that are not required to be tested. In addition, improper sanitation of preparation surfaces and equipment can transfer pathogens to fresh food products. Other possibilities of contamination for fresh food products include irrigating with fecal contaminated water and other possible areas.

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Salmonella

Salmonella is the most likely bacteria to be spread to humans by environmental applications of animal waste. Food poisoning is the most common infection form of *Salmonella*. *Salmonella* will survive in slurry conditions for approximately 77 days and will grow from 6° to 47° C.

Listeria monocytogenes

Found in soil, silage, and feces, *Listeria monocytogenes* is a food borne pathogen that causes several different clinical manifestations including abortion. It can survive and possibly grow at temperatures between 1° to 45° C. Listeriosis is the common term for the many clinical diseases linked to *L. monocytogenes* including, septicemia, meningitis (or meningoencephalitis), encephalitis, and intrauterine or cervical infections in pregnant women resulting in the aforementioned abortion.

Campylobacter

Campylobacter is a huge player in human gastro-enteritis bacterial infections. Found in raw sludge, *Campylobacter* is sensitive to anaerobic digestion making it a low risk pathogen. It generally causes heavy diarrhea with occasional abdominal cramps, fever, and nausea that are self-limiting and do not require treatment.

Mycobacterium paratuberculosis

Mycobacterium paratuberculosis is found worldwide and causes severe chronic enteritis known as Johne's disease in ruminants and may be linked to Cohn's disease in humans. Like the other bacteria, *M. paratuberculosis* is transferred from infected animals by fecal contamination of feed and water. In several countries, national eradication plans are in motion and herds must be certified *M. paratuberculosis* free before slaughter.

Figure 1 : Summary of Common Pathogens in Animal Manure causing Food Borne Illnesses

Pathogens in Animal Manure						
Bacteria	**Description**	**Habitat**	**Types of Foods**	**Symptoms**	**Cause**	**Temperature Sensitivity**
Staphylococcus aureus	Produces a heat-stable toxin	Nose and throat of 30-50 % of healthy population; also skin and superficial wounds	Mean and seafood salads, sandwich spreads and high salt foods	Nausea, vomiting and diarrhea within 4 to 6 hours. No fever.	Poor personal hygiene and subsequent temperature abuse	No growth below 40° F. Bacteria are destroyed by normal cooking but toxin is heat-stable.
Salmonella	Produces an intestinal infection	Intestinal tracts of animals and man	High protein foods-meat; poultry, fish and eggs	Diarrhea, nausea, chills, vomiting and fever within 12-24 hours	Contamination of ready-to-eat foods, insufficient cooking and recontamination of cooked foods	No growth below 40° F. Bacteria are destroyed by normal.
Clostridium perfringens	Produces a spore and prefers low oxygen atmosphere. Live cells must be ingested.	Dust, soil and gastrointestinal tracts of animals and man	Meat and poultry dishes, sauces and gravies	Cramps and diarrhea within 12 to 24 hours. No vomiting or fever.	Improper temperature control of hot foods and recontamination	No growth below 40° F. Bacteria are killed by normal cooking, but a heat-stable spore can survive.
Clostridium botulinum	Produces a spore and requires a low oxygen atmosphere. Produces a heat-sensitive toxin.	Soils, plants, marine sediments and fish	Home canned foods	Blurred vision, respiratory distress and possible DEATH.	Improper methods of home-processed foods.	Type E and Type B can grow at 38° F. Bacteria destroyed by cooking and the toxin is destroyed by boiling for 5 to 10 minutes. Heat resistant spore can survive. Watch for bulging cans or bottles.
Vibrio paphaemolyticus	Requires salt for growth.	Fish and shellfish	Raw and cooked seafood	Diarrhea, cramps, vomiting, headache and fever within 12 to 24 hours	Recontamination of cooked foods or eating raw seafood	No growth below 40° F. Bacteria killed by normal cooking
Bacillus cereus	Produces a spore and grows in normal oxygen atmosphere.	Soil, dust, and spices	Starchy food.	Mild case of diarrhea and some nausea within 12 to 24.	Improper holding and storage temperatures after cooking	No growth below 40° F. Bacteria killed by normal cooking, but heat-resistant spore can survive.
Listeria monocytogenes	Survives adverse conditions for long time periods.	Soil, vegetation and water. Cans survive for long periods in soil and plant materials	Milk, soft cheeses, vegetables fertilized with manure	Mimics meningitis. Immuno-compromised individuals most susceptible.	Contaminated raw products.	Grows at refrigeration (38° to 40° F) temperatures. May survive minimum pasteurization temperatures (161° F for 15 seconds).
Campylobacter jejuni	Oxygen sensitive, does not grow below 86° F.	Animal reservoirs and foods of animal origin.	Meat, poultry, milk, and mushrooms.	Diarrhea, abdominal cramps and nausea.	Improper pasteurization or cooking, cross-contamination.	Sensitive to drying or freezing. Survives in milk and water at 39° F for several weeks.
Enterpahtogenic Escherichia Coli	Can produce toxins that are heat stable and others that are heat-sensitive.	Feces of infected humans, animals.	Meat and cheeses.	Diarrhea, abdominal cramps, no fever.	Inadequate cooking. Recontamination of cooked product.	Organisms can be controlled by heating. Can grow at refrigeration temperatures.

Clostridium

A spore forming bacterium, the *Clostridium* species cause several major diseases including tetanus, botulism, and black leg resulting in major economic losses particularly in the dairy industry. *Clostridium* spores are found in silage and enter the cow and consequently, their milk when the silage is consumed. It is assumed that the spores originated from manure fertilizer residues used to produce the silage.

What can producers do?

Agriculture producers are often easy targets of food borne pathogen and environment contamination issues. Although concentrated production agriculture does leave an environmental footprint, other factors like municipal and wildlife contamination must be considered; the amount of contamination contributed cannot be calculated for each sector. In addition to proper herd management, there are several ways producers can minimize the amount of pathogenic fecal bacteria.

Proper Storage

Depending on the type of pathogen in question, proper storage can help lower pathogen levels. There are very few pathogens that are sensitive to proper and long storage times, but it is the first step and keeps pathogens contained to a particular area. Proper storage includes holding site and storage facility construction. The storage site should be away from the public eye and more than 500 feet away from ground or surface water sources. The facility should be constructed to prevent leaking and groundwater contamination by absorption.

Manure Processing

There are several manure processing options available for producers that have been proven to highly reduce or eradicate pathogenic bacteria. The most common and cost-efficient biological processes include aerated lagoons, composting, and biogas-producing anaerobic digestion. Lime stabilization, which combines high pH and exothermic heat, is a very potent chemical treatment option. Physical treatment options like manure/slurry separation are available, but usually have to be followed with a more effective biological or chemical process to really reduce pathogen levels.

Chemical processes can be very effective, but are also very costly. Biological processes tend to have a higher initial cost, but require little maintenance afterwards and continue to effectively reduce pathogen levels. However, for most biological processes the amount of pathogen reduction depends on the management of the facility and process. An exception to that rule is high heat anaerobic digestion. Other anaerobic digesters successfully isolate pathogens and allow pathogen kill before land application. It's important to note that the use of an anaerobic digester of some sort may be required in some states or nationwide in the future.

Tests

Quantitative microbial risk assessment (QMRA) procedures are useful in estimating the contamination factor for the production and specific pathogens. Knowing where the risks are can help producers eliminate both the risk and possibility of legal action against them.

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