PATHOGENS IN MANURE MANAGEMENT
Is Your Liquid Gold Safe?

Cynthia Martel, Extension Agent, Dairy Science
VCE Franklin County

IS YOUR LIQUID GOLD SAFE!

• Why is it important to monitor manure???
• Show of hands how many farms:
  1. Use manure on crop or pasture fields
  2. Recycle manure for bedding
  3. Sell for compost to businesses
  4. Sell or give away to the public for gardens.

PROTECTING THE FUTURE OF YOUR FARM THROUGH SAFETY AND KNOWLEDGE

DID YOU KNOW??

• Manure from livestock and poultry can contain pathogens and chemical contaminants that can cause diseases and illness in:
  • HUMANS
  • ANIMALS

• *Pathogens – anything that can cause a disease – disease producer.
• *Chemical contaminants – drugs or nutritional supplements.

PUBLIC HEALTH AND ANIMAL WASTE

• PATHOGENS (Microbes)
  • Bacteria
  • Protozoan
  • Viruses

• CHEMICAL CONTAMINANTS
  • Nutrients
  • Endocrine disrupters
  • Antimicrobials – link between overuse or off label use – cause selection of resistant bacteria.

MANURE-BORNE PATHOGENS OF CONCERN

Cryptosporidium parvum
Giardia lamblia
Campylobacter jejuni
Salmonella
E. coli

6 PATHOGENS FOUND IN DAIRY MANURE

• Salmonella
• E.coli
• Campylobacter jejuni
• Listeria monocytogenes
• Cryptosporidium parvum
• Giardia lamblia
HOW ARE PATHOGENS TRANSMITTED

• Direct contact with humans and animals and animal waste.
• Indirectly through contaminated food or water.
• Food contaminated during meat and milk processing
• Water contaminated by runoff either from:
  • Livestock facilities
  • Excessive land application of manure

NOT ALL PATHOGENS THE SAME!

• Pathogen survival can be dependent on
  • Longevity
  • Temperature
  • Manure processing

SURVIVAL & TRANSPORT OF PATHOGENS IN ENVIRONMENT

• Sunlight
• Drying
• Freezing and thawing cycles
• High Temperatures
• High or low pH
• Exposure to Oxygen
• Ammonia Concentration

E. Coli O157 & MANURE

• Cattle primary reservoir – greatest prevalence found in heifers and calves under 24 months of age.
• Calves recently weaned off milk highest prevalence.
• Feed deprivation may cause animals to increase their shedding.
• Fecal shedding in cattle has not been found to reflect grazing on forages that have been fertilized with cattle manure. **May indicate short survival period after being spread on fields.
• **E. coli levels shed in manure estimated at 3 – 50,000 cfu/gram of feces. Infective E. coli dose for humans is about 10 cfu.

LISTERIA & MANURE

• Bacterium naturally found living on plants and soil.
• Found on poorly fermented silage (high pH).
• Cattle shed more in feces during colder winter months
• Stress from birth and prolonged transport induces shedding.
• **Fresh vegetables fertilized with animal manure are important source of contamination for humans.
• **Extremely dangerous for humans—lower incidence of infection but higher death rate close to 20%.
SALMONELLA & MANURE

• Over 2000+ types of Salmonella – Fortunately only a few cause disease in cattle and humans.
• Up to 75% of dairies are positive on fecal cultures for salmonella.
• Over 50% of cattle are found to be shedding on the farm.
• Detected to survive for 286 days in slurry or lagoons.
• **Can come from contaminated feeds, rodents, wild animals and birds.

Mycobacterium paratuberculosis & MANURE
• Causative organism for Johne’s Disease.
• Infected cows may shed the pathogen in feces for months to years before showing clinical signs.
• Peak shedding = sheds millions bacteria/gram manure.
• Bacteria can live in environment for up to 1 year.
• **2 thimbles full of manure from infected cow enough to infect calf.

WATERBORNE DISEASE IN THE U.S.

• 12-20 outbreaks/yr
• Estimated 900,000 cases of waterborne microbial infections
• Up to 900 deaths
• > 70% in >55 yrs

Cryptosporidia & Giardia & MANURE
• Protozoan shed by wildlife, livestock and humans.
• Primary concern is water contamination from manure.
• Dairy calves 7-21 days old primary Crypto shedders.
• Beef calves 2-4 months old shedding
• Survives for long times in manure.
• Lagoons not usually contaminated unless flush system used to remove manure from calve pens or manure from calf barn disposed of in lagoon.
• **Humans become infected primarily during handling of calves.

HOW DO THESE BACTERIA AND PARASITES AFFECT HUMANS

• Acute gastrointestinal illness with:
  • Diarrhea
  • Abdominal pain
  • Fever
  • Nausea
  • Vomiting
• Some cases can progress to systemic infection involving other organ systems
• **COMPROMISED INDIVIDUALS, SICK, CHILDREN, ELDERLY ARE AT HIGHER RISK AND SYSTEMS CAN BE LIFE-THREATENING.

HOW DO YOU AS A PRODUCER BECOME BETTER STEWARDS AT PROTECTING YOUR ANIMALS, LAND, AND CONSUMER?
MANAGEMENT MANURE ON THE FARM

- Stacked Manure
- Composting
- Lagoon or slurry

Stacked – large piles not usually turned.
* Heating occurs, however non-homogeneously
* Pathogens can survive in unheated areas.
* Pathogens survive near outer crust of stack.
* Salmonella can survive up to 200 days in stacked manure.
* Usually spread on pasture between crops.

Lagoon or Slurry – During storage most pathogens decline in numbers from initial loading amounts.
* Storage for at least 1 month prior to spreading on land reduces levels of salmonellas.
* Temperature, dry matter content, and pH may not act directly on salmonella.
* The effect may favor growth of other organisms which in turn affect growth or survival of salmonella.

MANAGEMENT MANURE ON THE FARM

- Stacked Manure
- Composting
- Lagoon or slurry

Composting – Stacked manure is turned periodically.
* Insuring all areas of pile reach at least 131-149°F for 3 days of more.
* Turning eliminates areas within pile and near crust that might escape heating process.
* After turning and reaching recommended 145°F for several days, leave undisturbed for at least a month.

AIRBORNE-PATHOGENS: WISCONSIN STUDY 2012 – 2014

- Airborne pathogens from dairy manure aerial irrigation and the human health risk.
- Objectives:
  - Identify weather variables (wind speed, sola radiation, and relative humidity) that are important for airborne pathogen transport.
  - Estimate the risk of illness for people using a microbial risk assessment computer model.

  **Large, extensive study – 23 irrigation events – 8 trials with center pivot, 15 trials by traveling gun, 2 trials conventional tanker with high splash-plate method.

WISCONSIN STUDY RESULTS

- Bacteroides, gram negative bacteria, E. coli and Enterococci – 100% present in manure
- Campylobacter jejuni – present in manure
- **Non-pathogenic E. Coli – 100% detection in manure sample vs. 11% air samples.
- **Bacteroides – 100% detection in manure sample vs. 86% air samples.

WHAT DOES THIS TELL US??

- Concentrations of bacteria in air decreased with increasing distance downwind from manure irrigation or spreading.
- Concentration of bacteria with highest survival rate (most likely to cause illness) decreased approximately 30% for every 100-foot increase in downwind distance.
WHY ARE CONCENTRATIONS LESS IN AIR??

• 1. Liquid manure released through irrigation nozzle = fewer bacteria aerosolized & suspended in air.
• 2. Gravitational settling of manure aerosols onto surfaces, plant and soil = reduces aerosol-associated bacteria from air stream.
• 3. Dilution by wind = scattering & dispersing manure aerosols and bacteria into larger space (atmosphere) = reduced concentration.
• 4. Inactivation by: warm temperatures, low humidity, and sunlight = kills bacteria reducing numbers in the air.
• ***Applying Manure multiple times on a field during growing season increased exposure and risk of illness.

HOW DO YOU REDUCE EXPOSURE.

• We need to evaluate the health impact:
  • Occurrence
  • Survival/Persistence
  • Dissemination/Transport

• HOW IS THE PATHOGENS MOVING:
  • Manure
  • Management systems
  • Surrounding environment: Water, Air, Soil

SURVIVAL FACTORS OF PATHOGENS IN MANURE

• Type of slurry or manure
• pH
• Dry matter content
• Temperature
• Number & type of pathogen present
• Presence of competing organisms

CONTAMINATION ROUTES

• AEROSOLS
  • Direct transmission or deposition onto food crops, fomites, or water
  • Livestock spray irrigation
  • Liquid Manure or Biosolids land application

PATHOGEN TRANSPORT POSSIBLE
# Dissemination of Manure

- Land Application
- Aerosol generation
- Leakage or overflow from storage lagoons or treatment ponds
- Runoff from feed yards, manure applied land, pasture land, etc.

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# Outbreaks Do Happen!

- 2001 – Walkerton et al
  - Land-applied cattle manure
  - Ag runoff into groundwater supply caused:
    - *Escherichia coli* O157:H7 and *Campylobacter*
    - >2000 cases
    - 7 fatalities
  - Linked to Rocky Ford cantaloupe outbreak
    - *Listeria monocytogenes*
    - Dump truck traveled through manure that cross contaminated packing house area (part of problem)
    - 33 fatalities (147 hospitalized)

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# What Can You as a Farm to Do Reduce Risk??

- Use of vegetative filter strips – to control runoff and erosion.
- Control runoff and leaching from stockpiled manure, open lots.
- Install clean-water diversion – berms and ditches to divert runoff to proper collection areas.
- Eliminate or reduce livestock access to streams, rivers, lakes, ponds.
- Educate yourself about pathogens and teach homeowners who might be using manure from your farm about the importance of proper timing: how long manure should set before using in gardens, etc.