PATHOGENS IN MANURE MANAGEMENT
Is Your Liquid Gold Safe?

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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

Protozoan Parasites

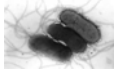
Cryptosporidium parvum

Giardia lamblia

Fungi

Viruses

Campylobacter jejuni



Pathogenic Bacteria

Salmonella

E. coli

Antibiotic Resistant Bacteria

6 PATHOGENS FOUND IN DAIRY MANURE

- *Salmonella*
- *E.coli*
- *Campylobacter jejuni*
- *Listeria monocytogenes*
- *Cryptosporidium parvum*
- *Giardia lamblia*

HOW ARE PATHOGENS TRANSMITTED

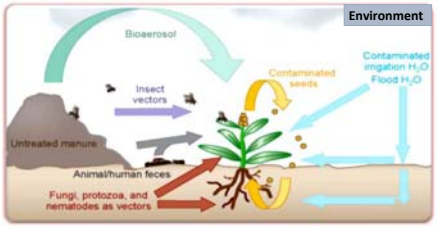
- Direct contact with humans and animals and animal waste.
- Indirectly through contaminated food or water.
  - Food contaminated during meat and milk processing
  - Water contaminated by runoff either from:
    - Livestock facilities
    - Excessive land application of manure

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



- Number and types of pathogens present in livestock waste varies by:
  - Animal species
  - Feedstuff sources
  - Health status of animals
  - Characteristics of manure
  - Manure storage facility

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.
- Cattle shed between 20 – 50,000 cfu/gram of salmonella in manure.
- Detected to survive for 286 days in slurry or lagoons.
- Survival in manure highly dependent on temperature and ammonia concentration – studies show 90% reduction in slurry in 30 days.
- **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.
- Forage crops that have fresh manure applied as fertilizer as a feed risk to young stock.
- 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

Recreational

Irrigation

Foodborne

Drinking

****NOT BROKEN DOWN BY SOURCE OF CONTIMINATION

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

FDA – RECOMMENDS 120-DAY INTERVAL BETWEEN APPLICATION OF RAW MANURE FOR CROPS IN CONTACT WITH THE SOIL. 90 DAYS FOR CROPS NOT IN CONTACT WITH SOIL.

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.

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.

MANAGEMENT MANURE ON THE FARM

- Stacked Manure
- Composting
- **Lagoon or slurry**

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.

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

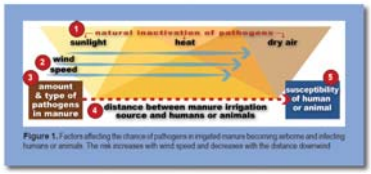
- *Bacteroides*, gram negative bacteria, *E.coli* and *Enterococci* – 100% present in manure
- *Campylobacter jejuni* – present in manure

Detected concentration high in manure samples, downwind air samples concentration less

- **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.



- ****TAKE HOME MESSAGE BE COGNIZANT OF YOUR NEIGHBORS HOMES, GARDENS, AND WELLS!

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

SURVIVIAL 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

CONTAMINATION ROUTES

PATHOGEN TRANSPORT POSSIBLE

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

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.

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)

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.