Distribution of Microbial Community in Dairy Manure Applied to Agricultural Land

Pramod K. Pandey and Michelle L. Soupir

Dept. of Agricultural and Biosystems Engineering, Iowa State University

Pius M. Ndegwa

Dept. of Biological Systems Engineering, Washington State University

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Problem and Proposition

Problem: Influx of pathogens into agricultural land through dairy manure application

Proposition: To use aerobic or anaerobic or both reactors, under improved conditions, to minimize the number of pathogens in dairy manure

Processes

Organic Matter → $CO_2 + CH_4$

Anaerobic Reactor

Organic Matter + O_2 → $CO_2 + H_2O$

Aerobic Reactor

Traditional and Proposed Use of Reactors

Traditional:

- Anaerobic

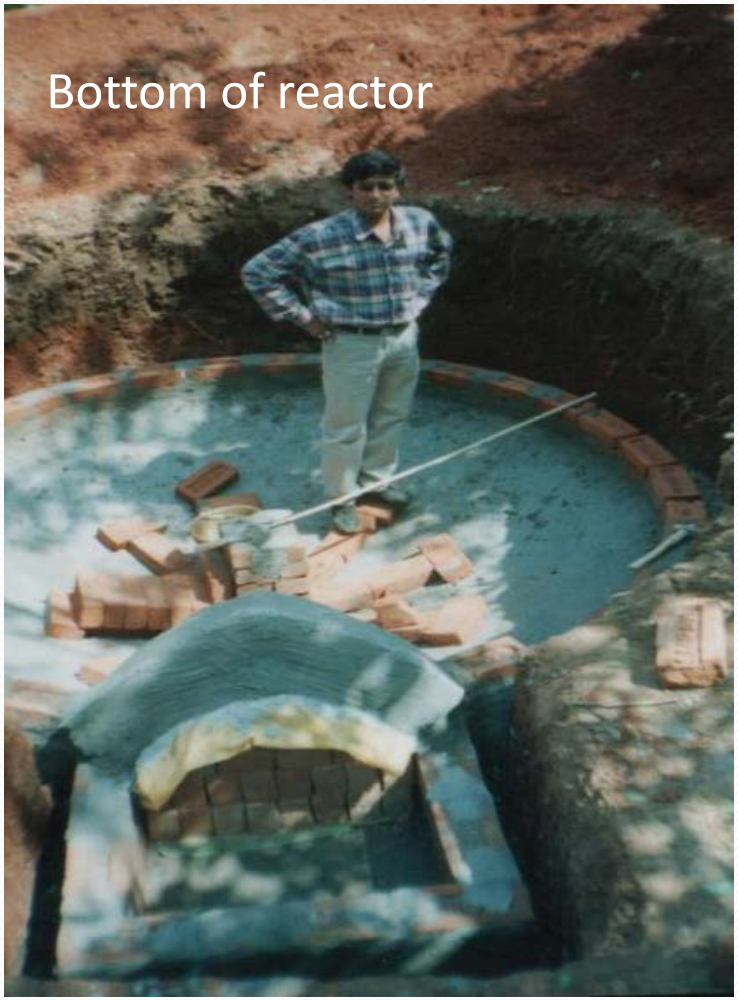
  Methane production through degradation of organic matter
- Aerobic

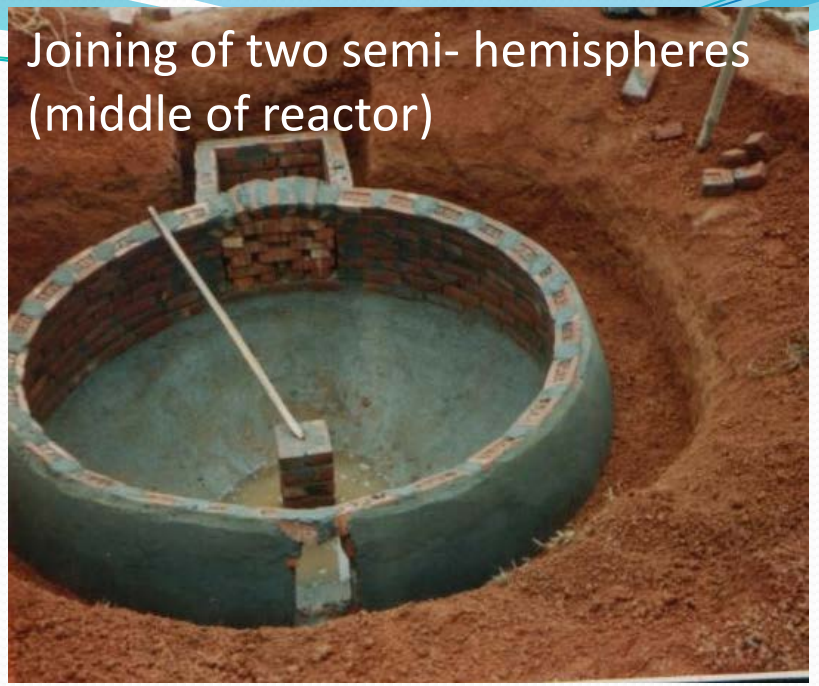
  Organic matter degradation

Proposed:

Both reactors can be used to reduce the number of pathogens in dairy manure. Subsequently, it will decrease the influx of pathogens into agricultural land.

Reactor Design





Goal and Objectives

To understand the growth/die-off characteristics of *E. coli* in dairy manure under aerobic and anaerobic environment

- Study the morphological changes (size) of *E. coli* under aerobic and anaerobic conditions
- Understand the effects of aerobic and anaerobic conditions on *E. coli* growth dynamics
- Optimize the required Hydraulic Retention Time (HRT) for reducing *E. coli* in aerobic and anaerobic processes
- Develop recommendations for controlling pathogens in dairy manure applied to agriculture land

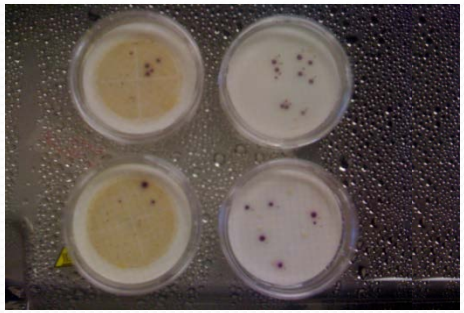
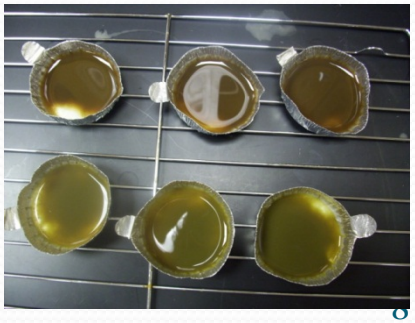
Lab-scale Reactors

Organic ma
(manure)

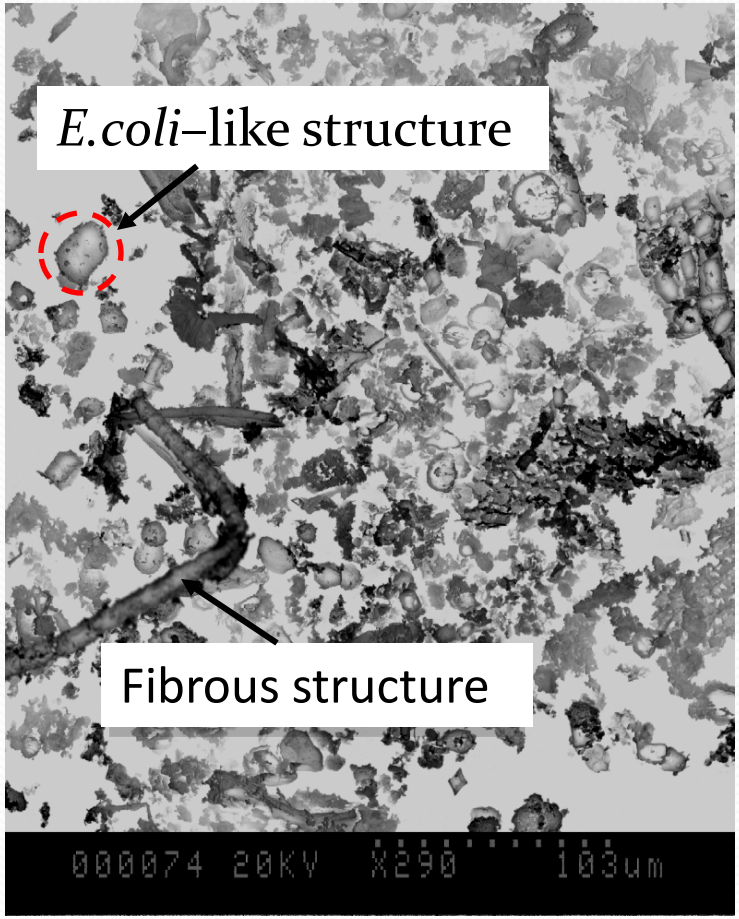
Methodology

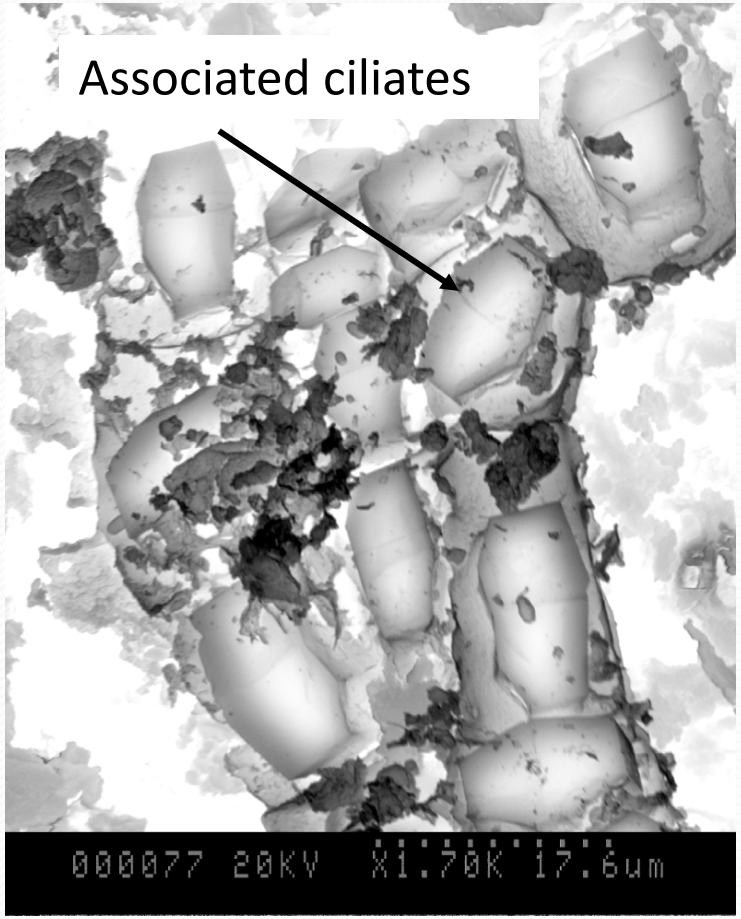
- Use Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) for morphological analysis of initial manure samples
- Prepare the batch reactors
  - Create the aerobic and anaerobic conditions
  - Maintain the mesophilic temperature (37°C)
  - Sample the digested slurry from both reactors with time
  - Analyze daily for *E. coli*, pH, Total Solids, Volatile Solids, biogas, and oxidation-reduction potential (ORP)



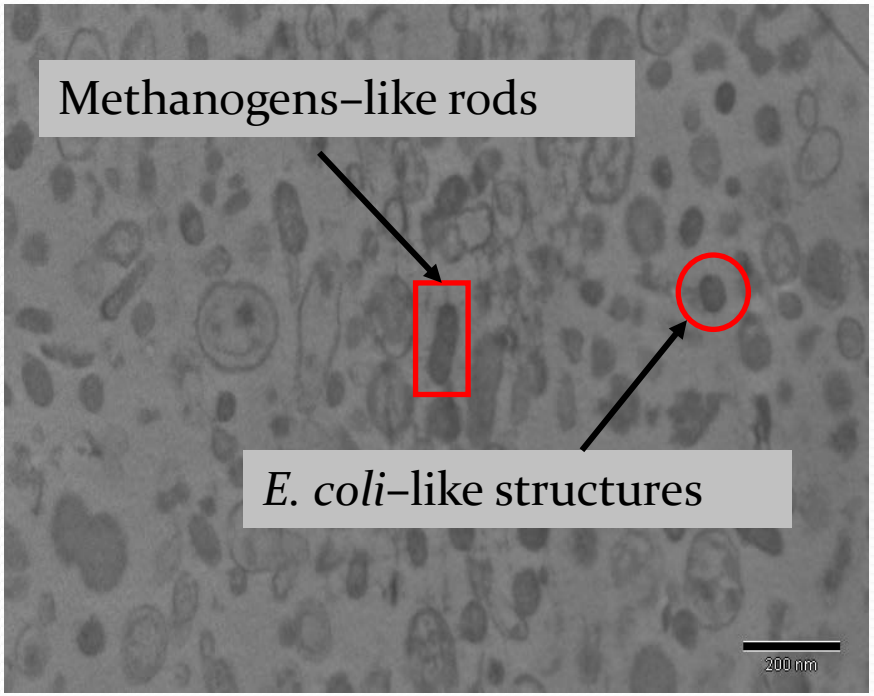



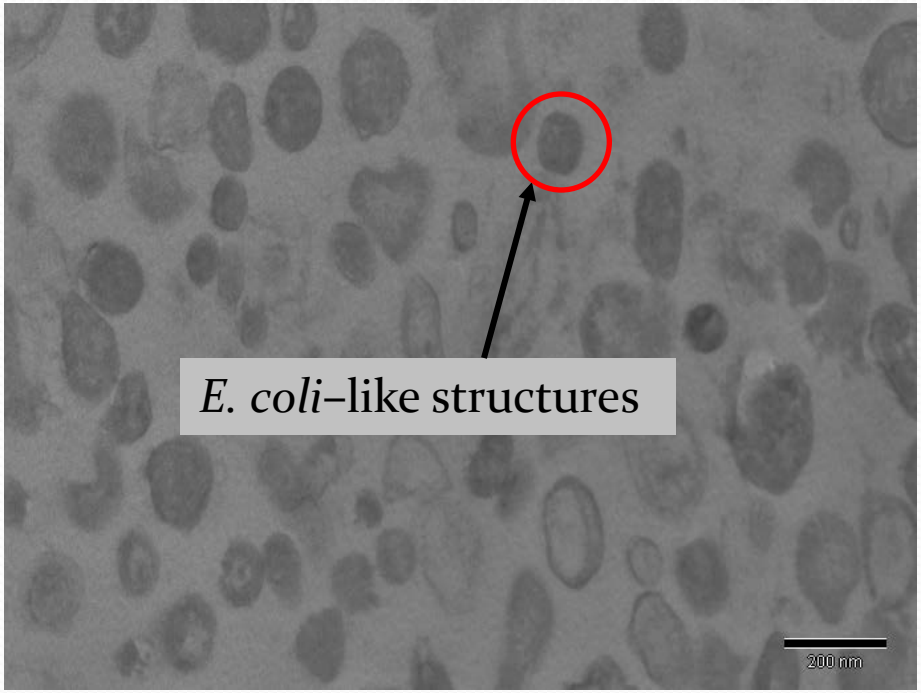
SEM Analysis of Dairy Manure



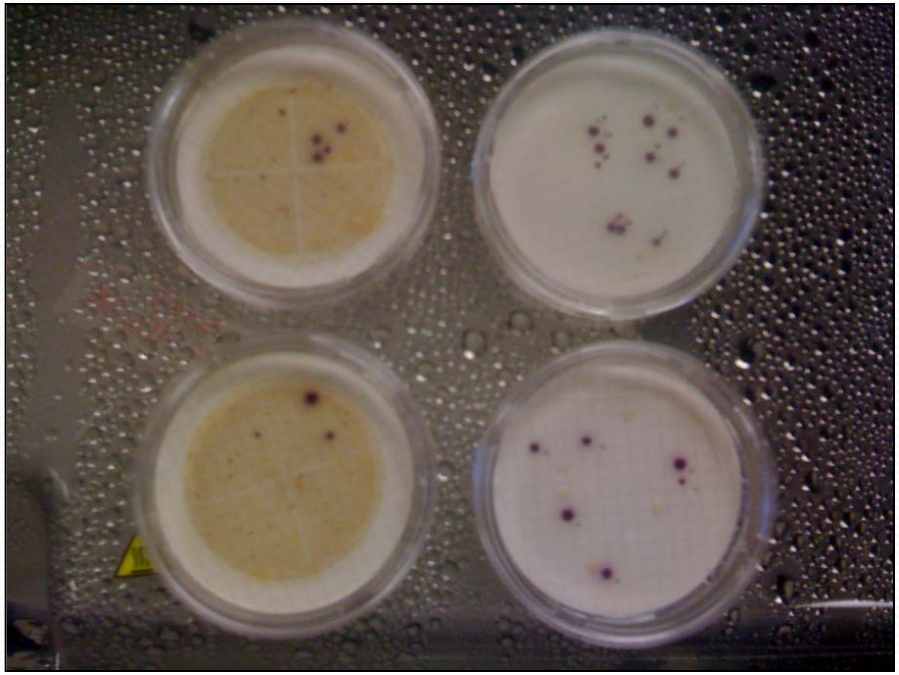


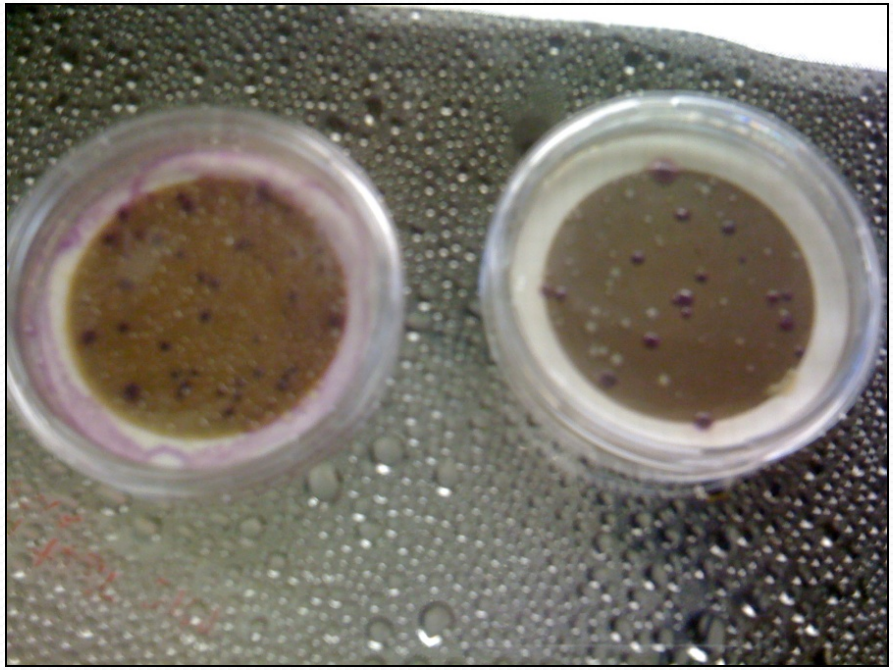
TEM Analysis in Dairy Manure



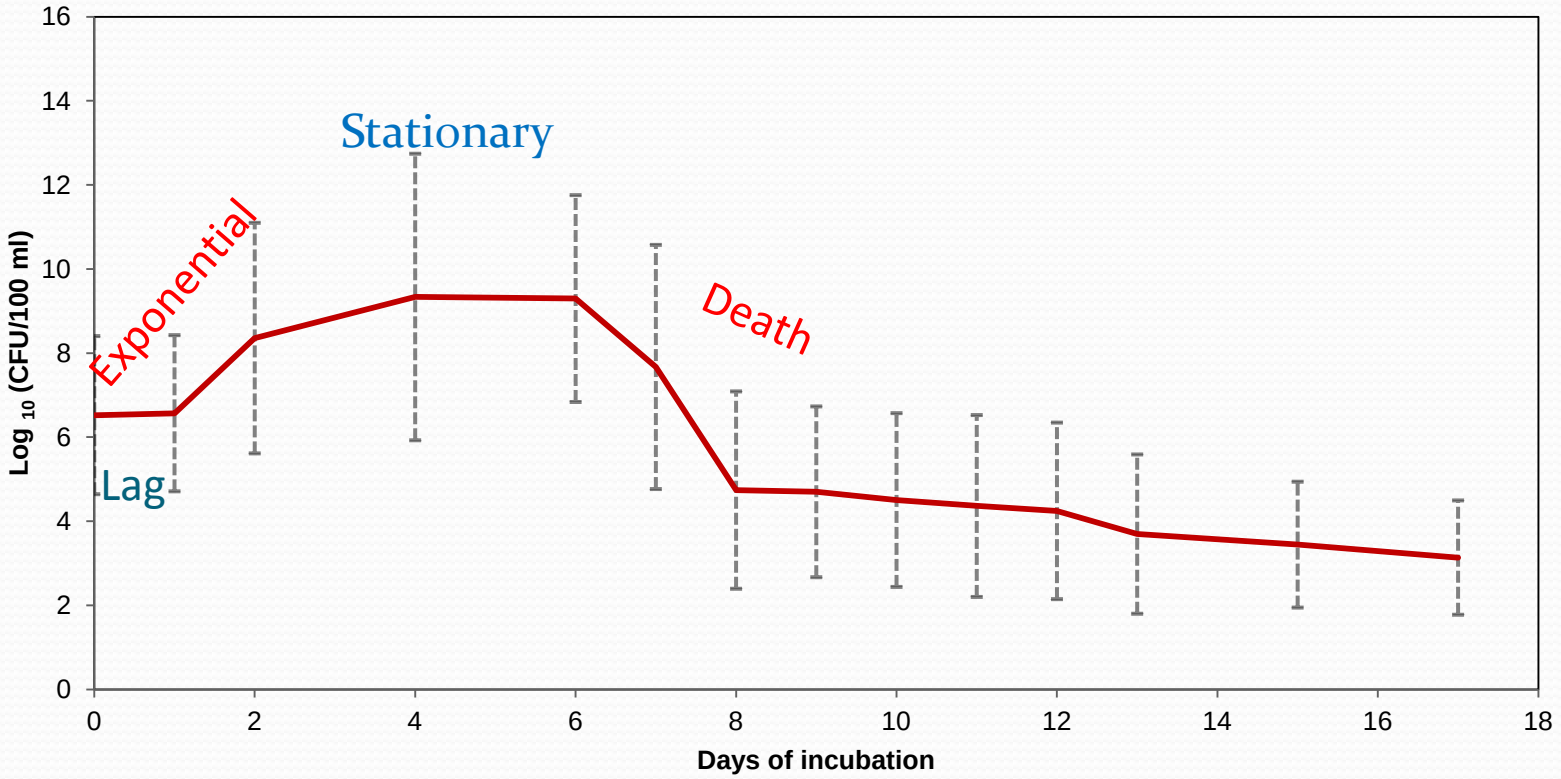


Cell Enumeration

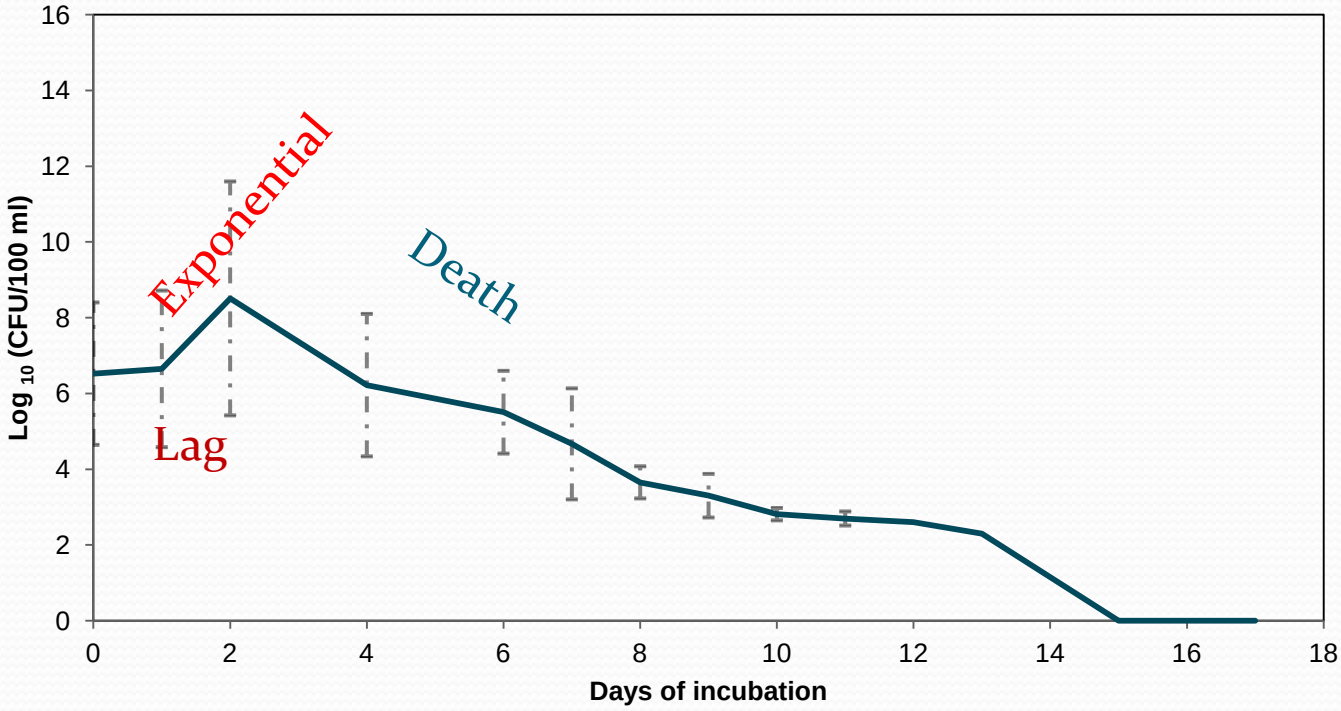




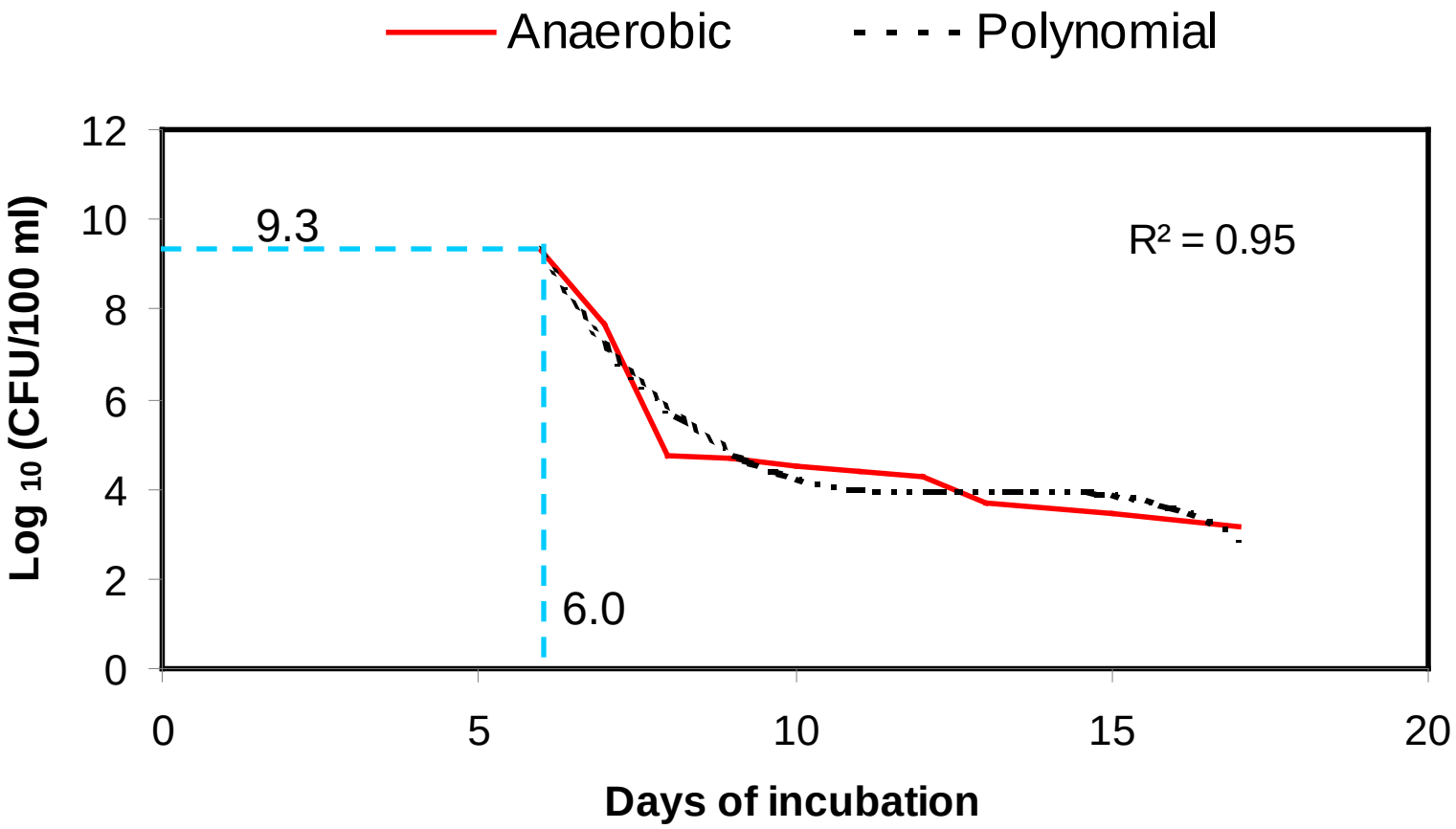
Growth Curve of *E. coli* under Anaerobic Condition



Growth Curve of *E. coli* under Aerobic Condition



Death Phase for *E. coli* Populations under Anaerobic Condition



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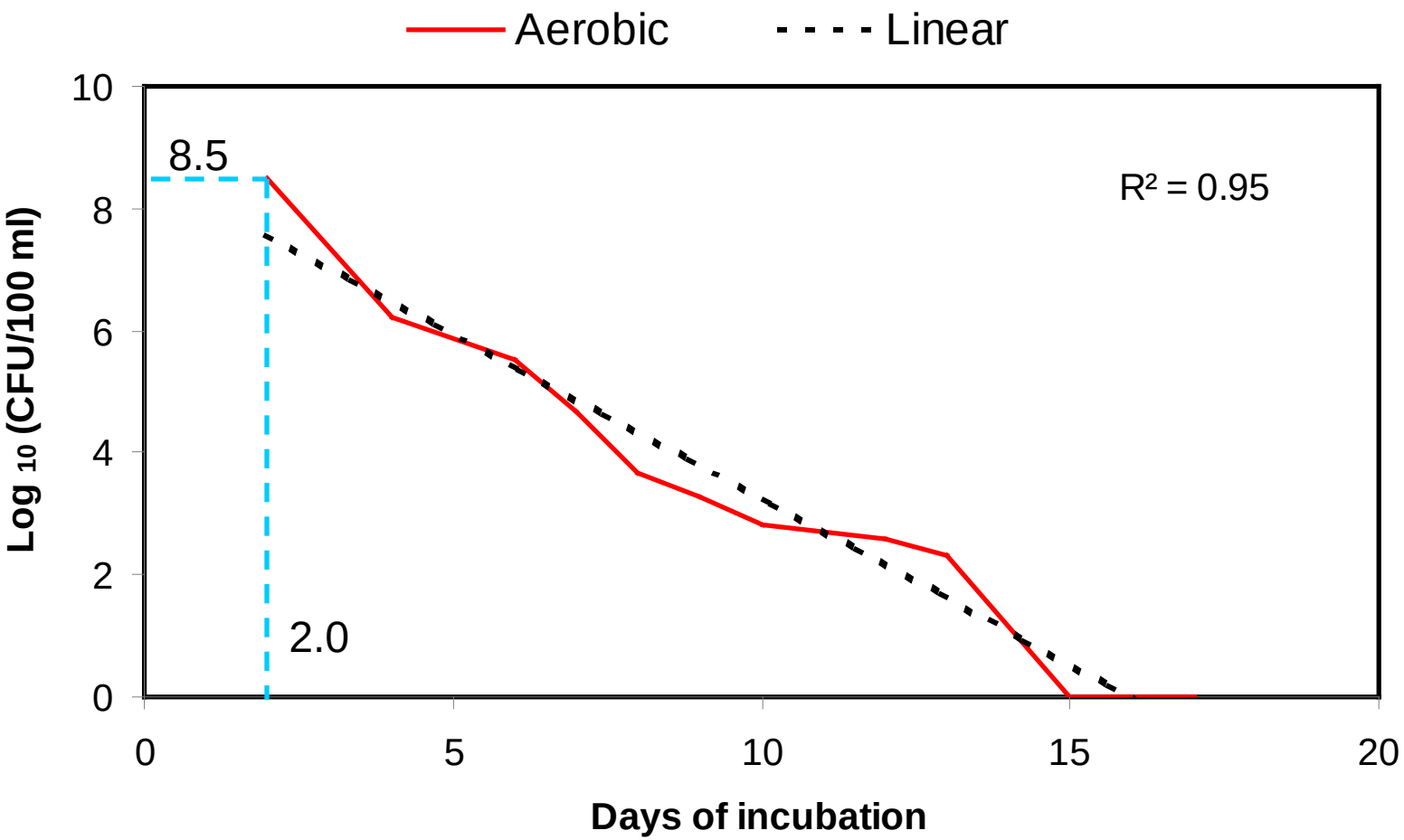
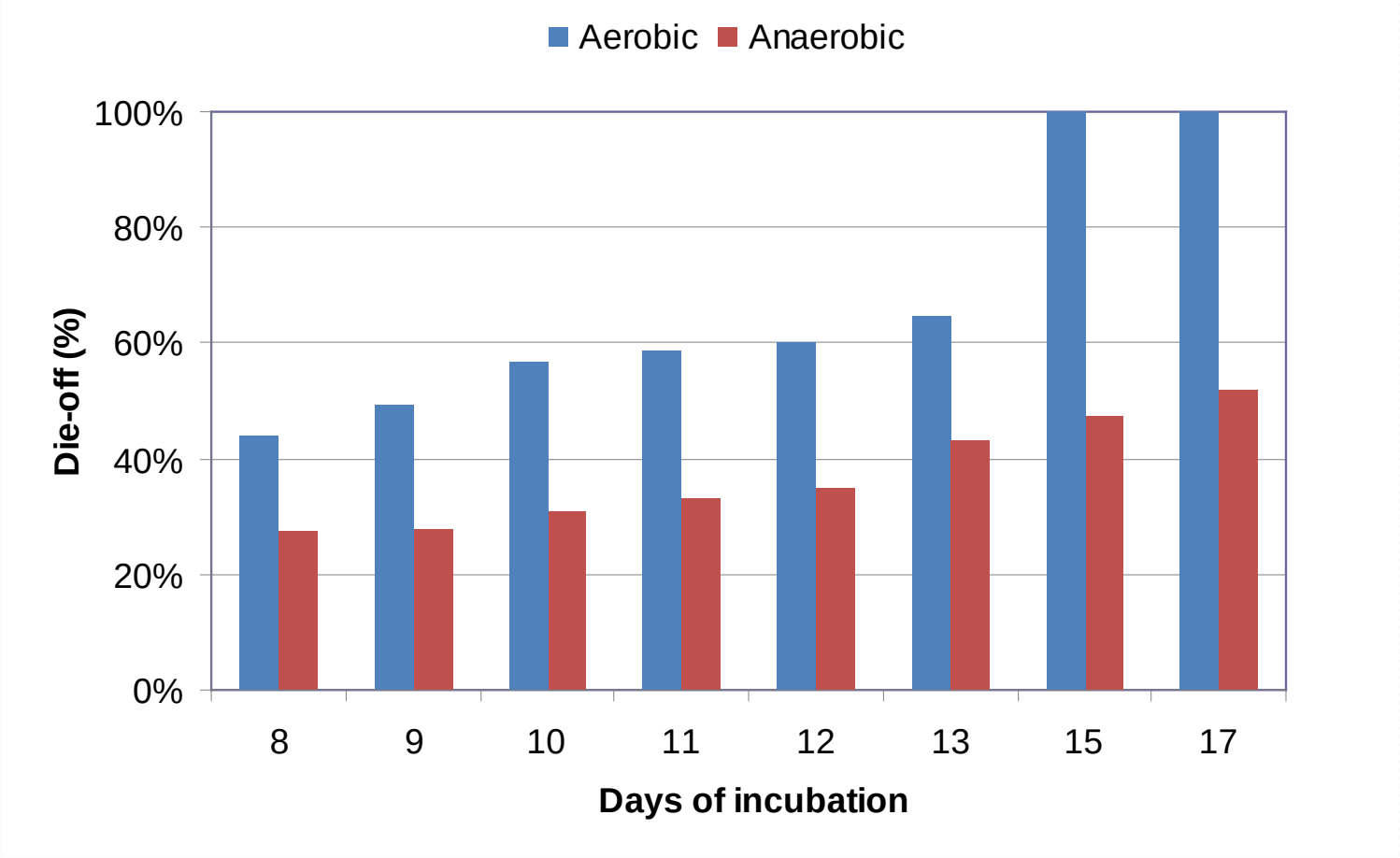
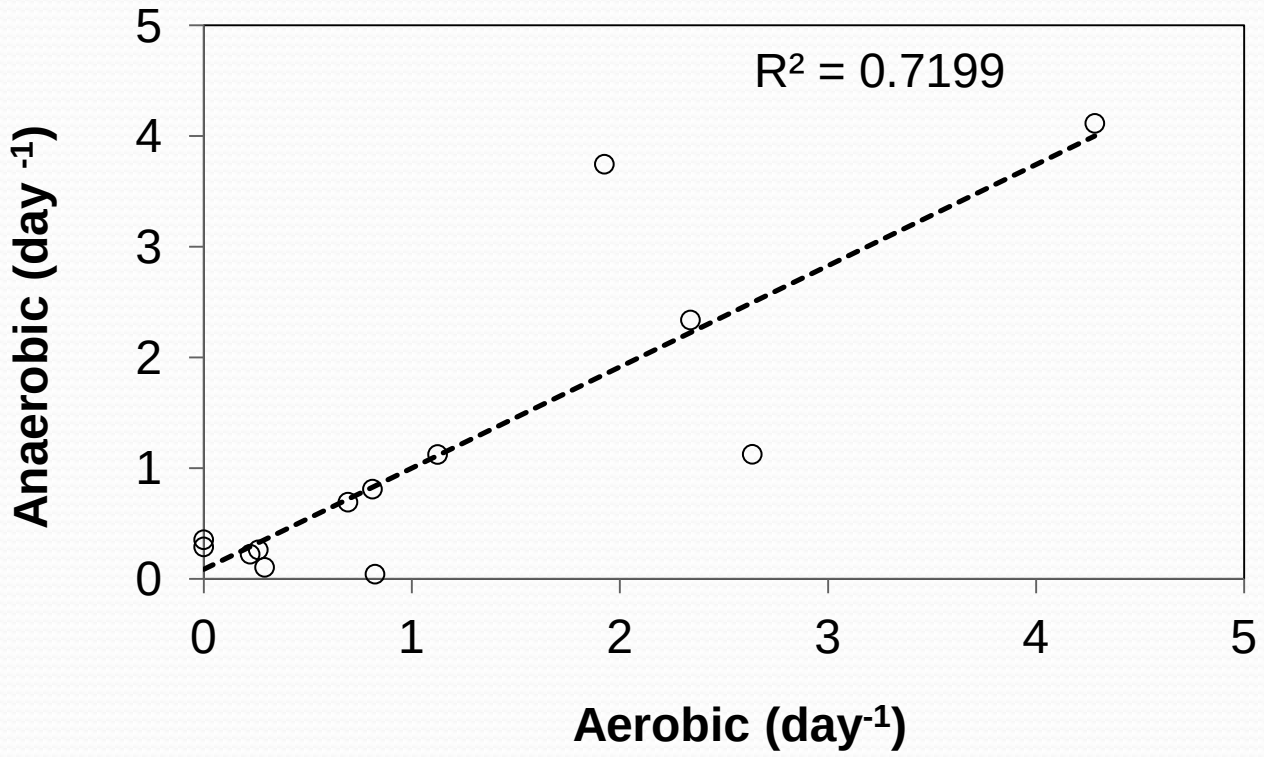


Die-off Percentage of *E. coli* under Aerobic and Anaerobic Conditions

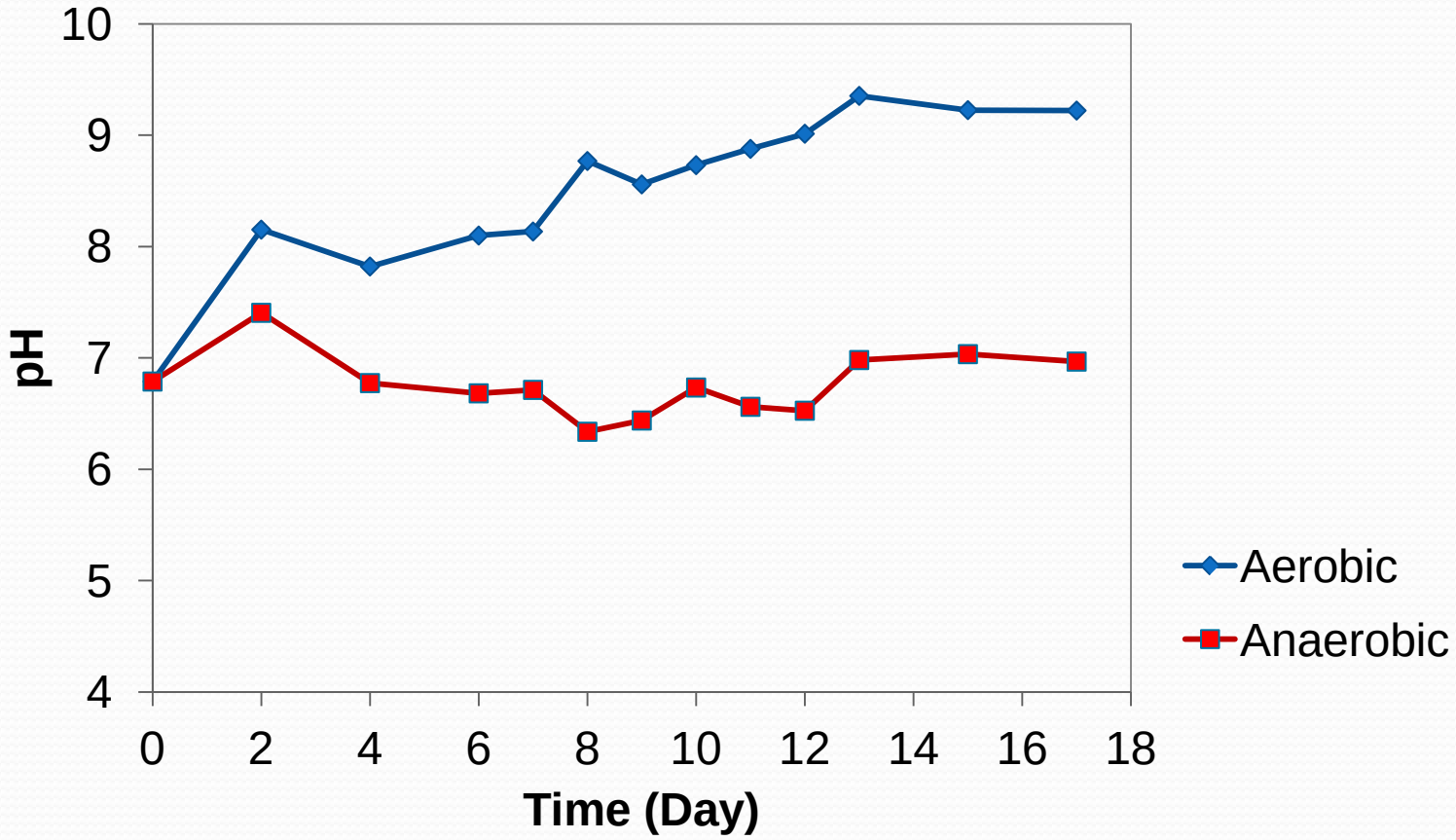


Specific Growth Rate of *E. coli* in Dairy Manure

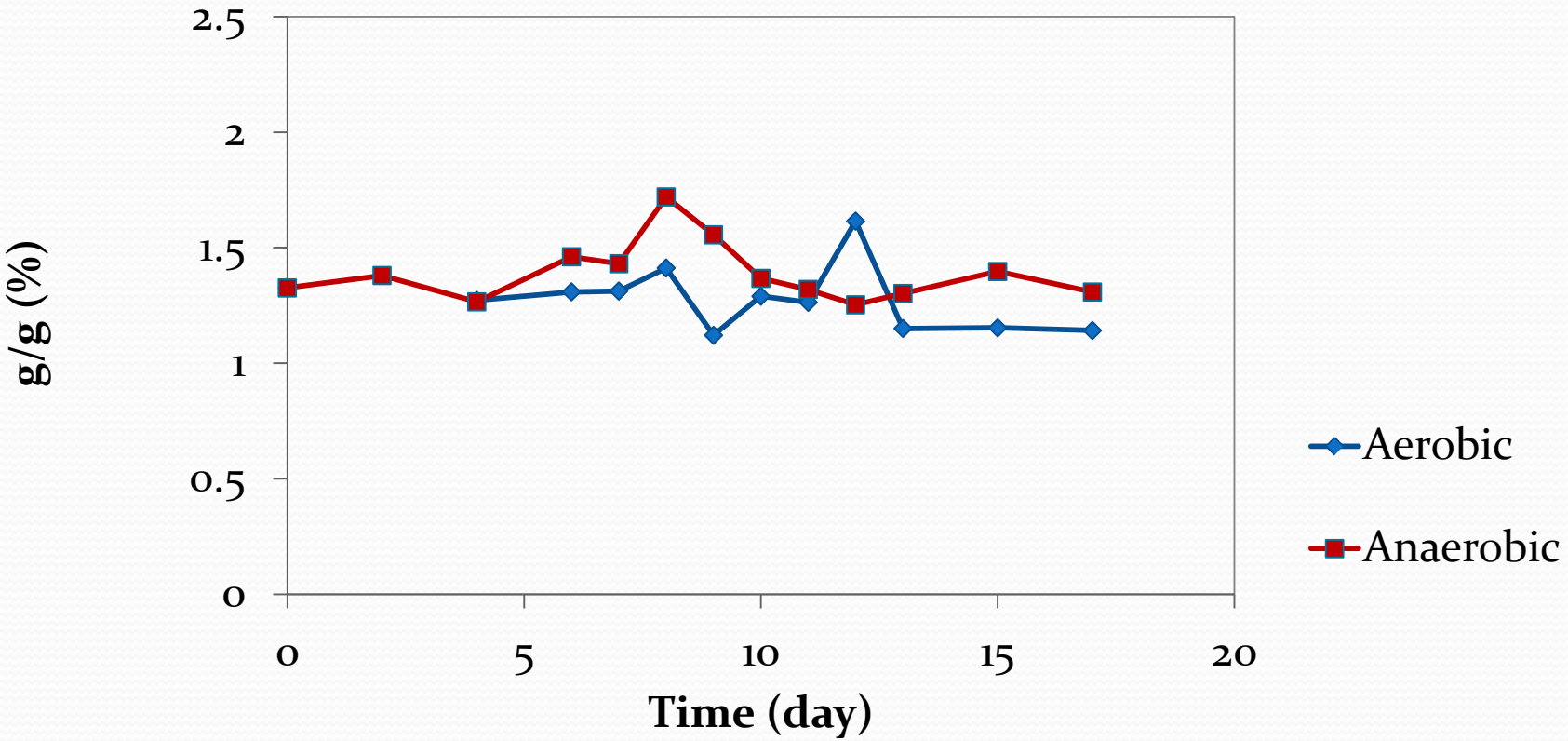
$$Specific\ growth\ rate = ABS\left[\frac{\ln(X2) - \ln(X1)}{t_2 - t_1}\right]$$



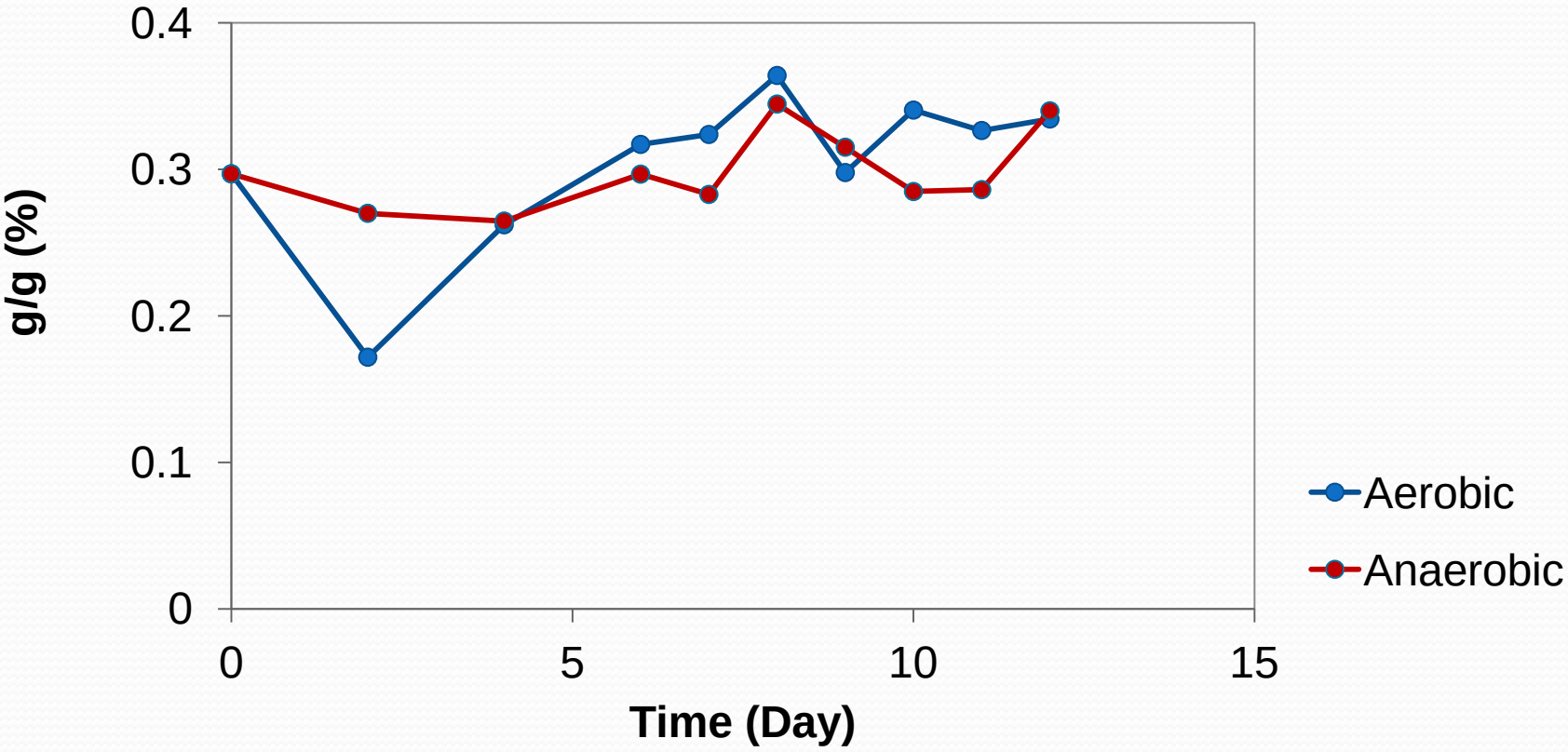
pH: Aerobic and Anaerobic Conditions



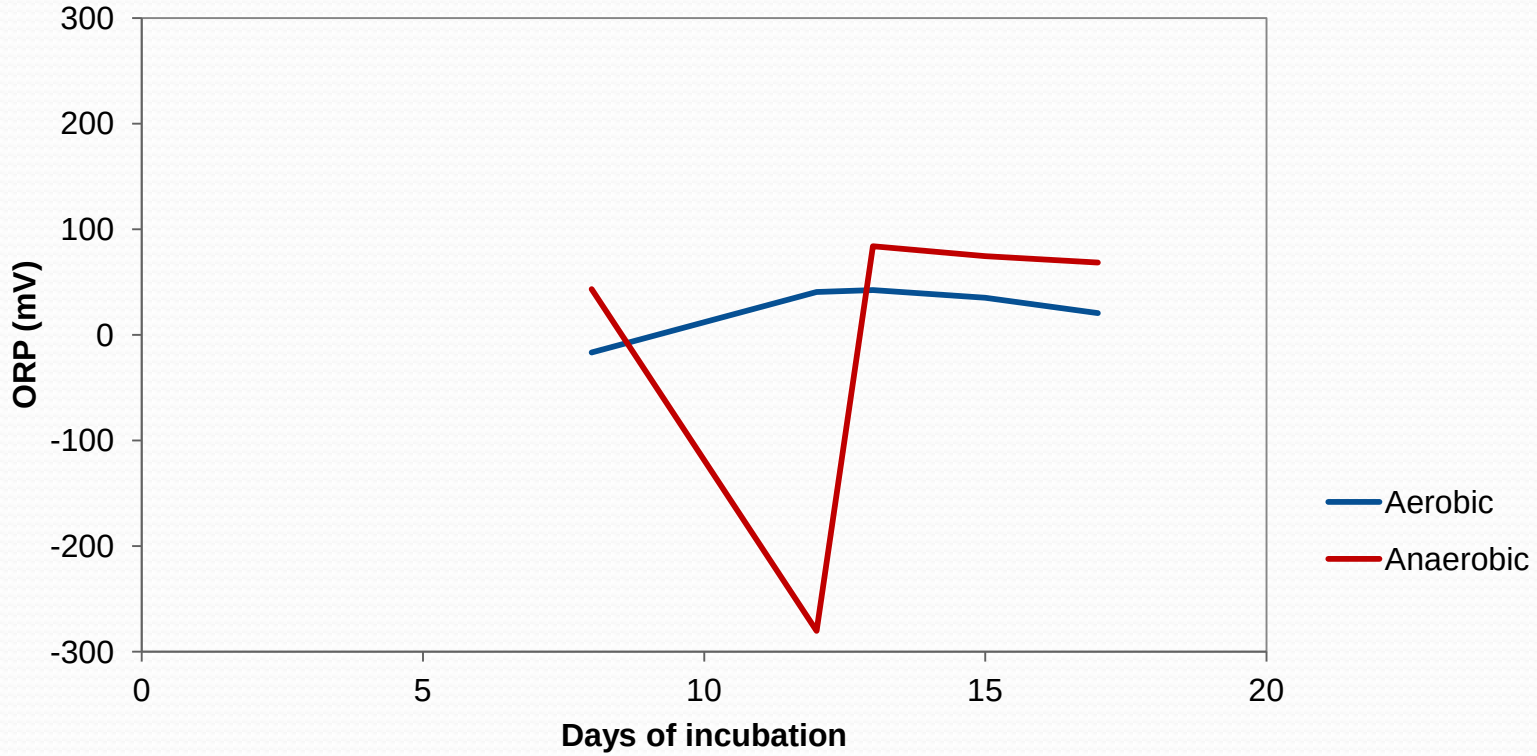
Total Solids: Aerobic and Anaerobic Conditions



Volatile Solids: Aerobic and Anaerobic Conditions

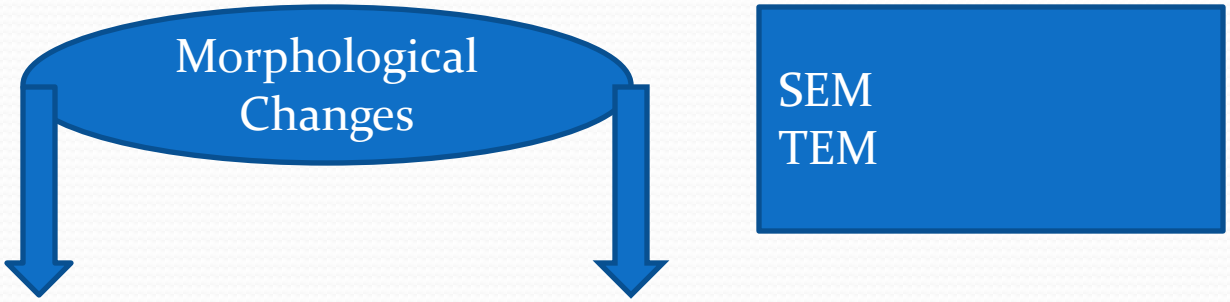


Oxidation-reduction potential (ORP)



Future Plan…

- Extend the experiment for thermophilic conditions
- Study the morphological changes



Aerobic
•Mesophilic Temp.
•Thermophilic Temp.

Anaerobic
•Mesophilic Temp.
•Thermophilic Temp.

Conclusions

- In terms of destruction of *E. coli*, aerobic process was more efficient
- Aerobic process achieved 90-100% *E. coli* destruction in dairy manure in 2 weeks
- *E. coli* survived longer in anaerobic reactors
- Anaerobic reactors are advantageous in terms of methane production. However, in terms of E.*coli* destruction, it was less efficient
- *E. coli* growth and die-off characteristics could be important in modifying/improving the current reactors/processes used for dairy manure treatment

Thank you