

# Backyard Biogas Production

Shane Philhower<sup>1</sup> and Ann C. Wilkie<sup>2</sup>

<sup>1</sup> Soil and Water Science Department, College of Agricultural and Life Sciences

<sup>2</sup> Faculty Mentor, Soil and Water Science Department, University of Florida-IFAS, Gainesville, Florida



## Abstract

Anaerobic digestion is a biological process in which organic matter is converted into biogas by microbes in the absence of oxygen. Biogas can be made from any type of organic biomass and applications range from rural household digesters to industrial-scale systems at livestock farms and wastewater treatment facilities. The purpose of this research was to evaluate common feedstocks, such as grass clippings, live oak leaves, and chicken manure. Fresh samples were analyzed for dry matter (DM) and organic matter (OM) according to Standard Methods. Fresh samples were dried and ground to 0.85 mm using a Wiley Mill for methane index potential (MIP) batch assays conducted at 35°C, in triplicate. Chemical oxygen demand (COD) was measured to determine a theoretical methane yield potential for each feedstock. Methane yields for chicken manure (166 L CH<sub>4</sub>/kg COD) and grass clippings (169 L CH<sub>4</sub>/kg COD) reached 48% of their theoretical methane yield within 30 days. Although live oak leaves had similar COD concentrations as grass clippings, their methane yield was extremely low, likely due to their waxy leaf surface and tannic acid content. Grass clippings and chicken manure are suitable feedstocks for anaerobic digestion, whereas live oak leaves are best suited as a bulking agent for aerobic composting.

## Introduction

Florida's semi-tropical climate allow the State to produce more biomass than any other, at nearly 7% the nation's annual average production<sup>1</sup>. Biomass stores the sun's radiant energy in the form of organic molecules which can then be converted into biofuels.



Grass Clippings

## Potential benefits to using Florida yard waste as a feedstock for anaerobic digestion:

- Grass grows abundantly and grass clippings could be utilized as a readily available feedstock for biogas production.
- Producing biogas from organic waste streams is beneficial as it captures methane for energy that would otherwise enter the atmosphere and creates nutrient-rich soil amendment byproducts.
- Florida's warm climate can facilitate anaerobic digestion for much of the year.

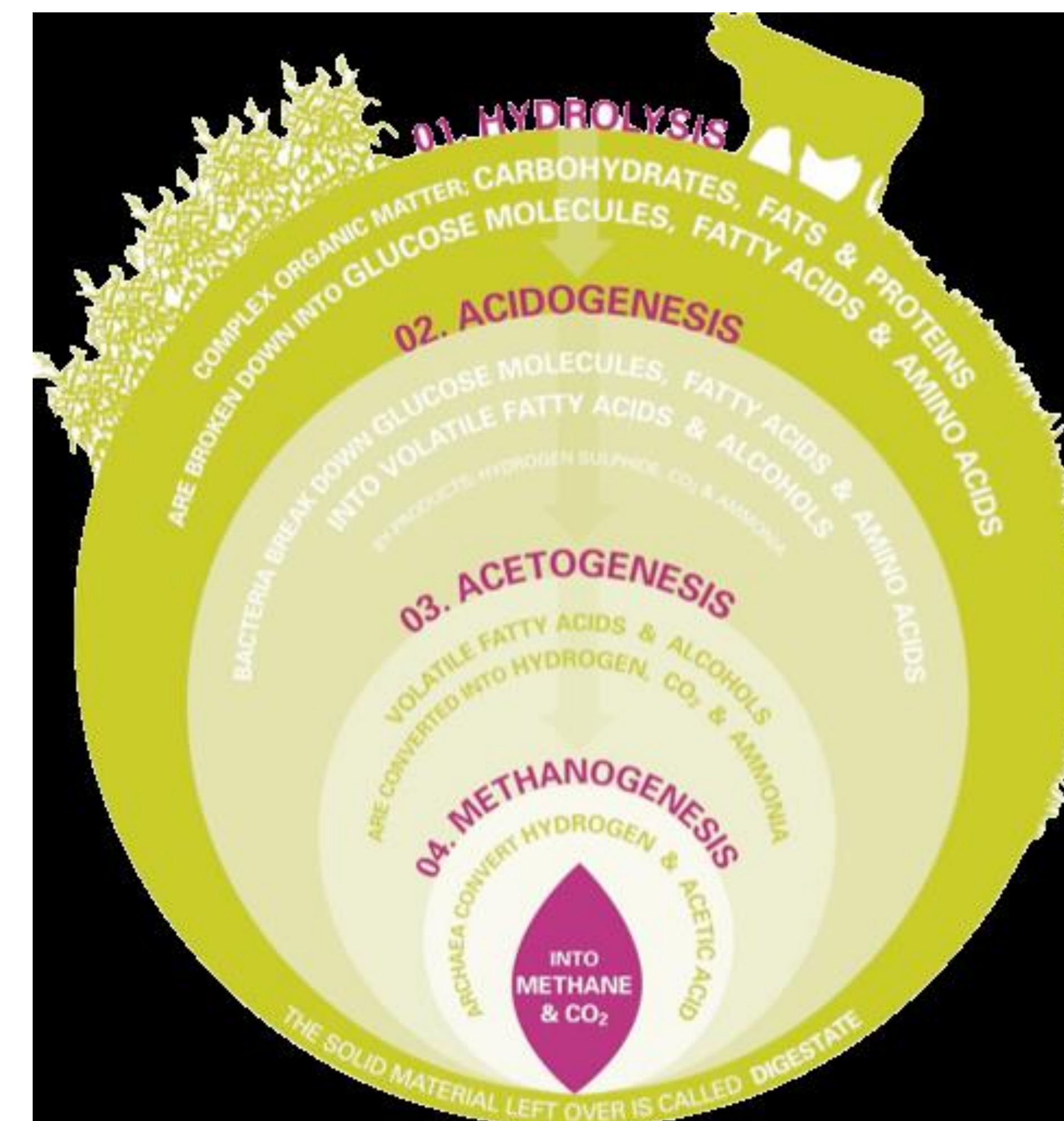


Backyard Chickens

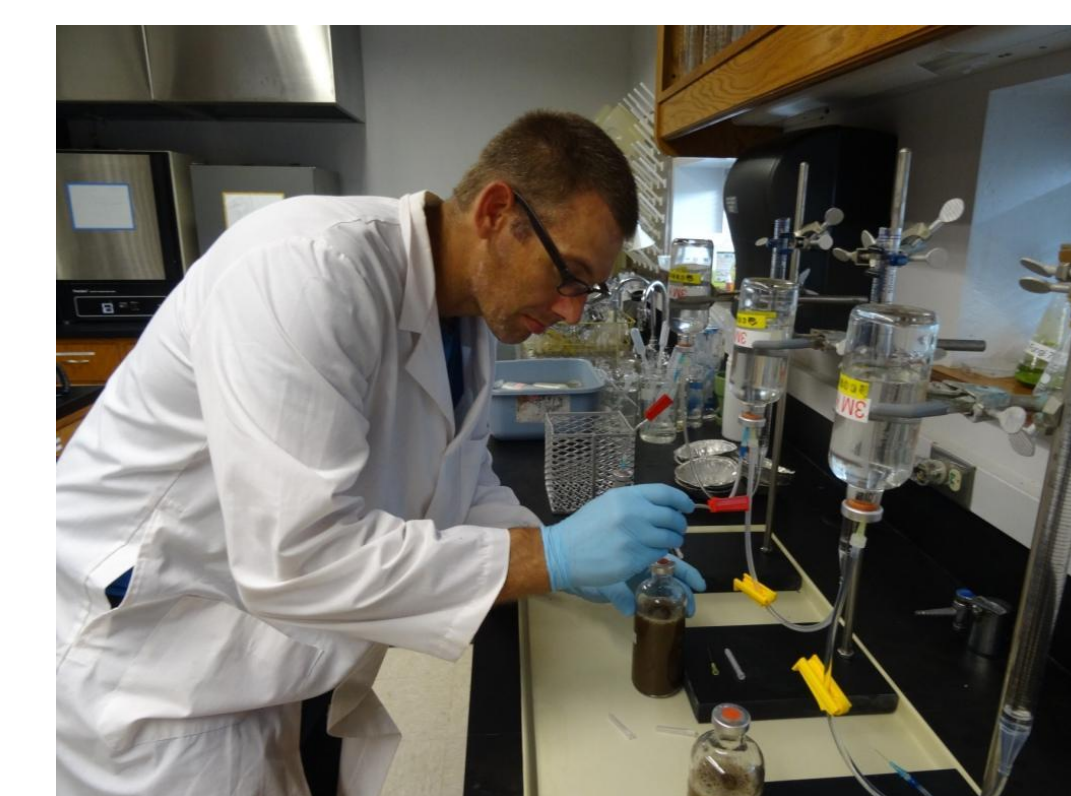
## Objective

Determine the biogas potential of common backyard biomass feedstocks – grass clippings, live oak leaves, and chicken manure.

Figure 1. Biochemical reactions involved in Anaerobic Digestion



0.85 mm particle size achieved with Wiley mill



Methane Index Potential Assay

## Methods

- **Feedstock characterization** for dry matter (DM), organic matter (OM) and Chemical Oxygen Demand (COD) according to standard methods<sup>2</sup>.
  - DM (drying at 105°C for 24 hrs)
  - OM (ashed at 550°C for 2 hrs)
- **Methane Index Potential (MIP) Assays<sup>3</sup>:**
  - DM mechanically ground to 0.85 mm with a Wiley mill
  - Organic loading at 2 g COD/L
  - Maintained mesophilic temperature of 35°C for 30 days
  - Triplicate assays for each feedstock
  - Methane gas measured using volumetric displacement method

Table 1. Characterization of Feedstocks

	Grass Clippings	Live Oak Leaves	Chicken Manure
Dry Matter (% wet)	23.6 ± 1.6	58.2 ± 3.7	62.9 ± 1.2
Organic Matter (% DM)	91.8 ± 0.3	51.2 ± 8.5	53.4 ± 2.0
Total COD (mg/g DM)	1133 ± 17	1071 ± 87	692 ± 52

## Results

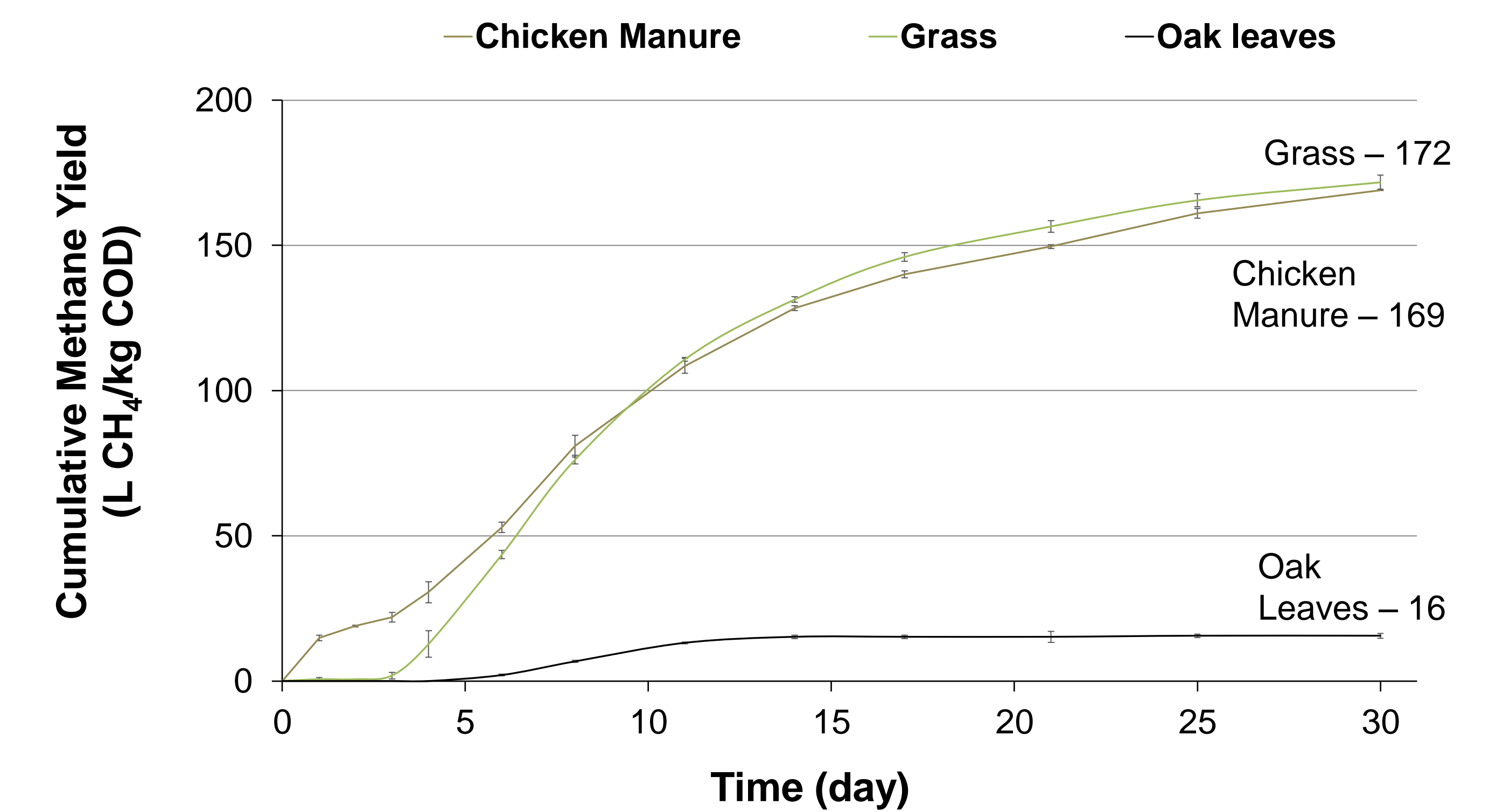


Figure 2. Cumulative methane yields for grass clippings, live oak leaves, and chicken manure

## Conclusions

- The data from the MIP assay shows that both the grass and the chicken manure achieved similar methane yields based on their COD, with grass achieving 47% percent of its maximum methane yield potential and chicken manure 48%.
- The live oak leaves performed the least, achieving just under 2% of the maximum methane yield potential, likely due to their waxy leaf surface and tannic acid content.
- Grass clippings and chicken manure are suitable feedstocks for anaerobic digestion, whereas live oak leaves are best suited as a bulking agent for aerobic composting.

## References

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