# Anaerobic Digestion of Culled Tomatoes to Produce Biogas

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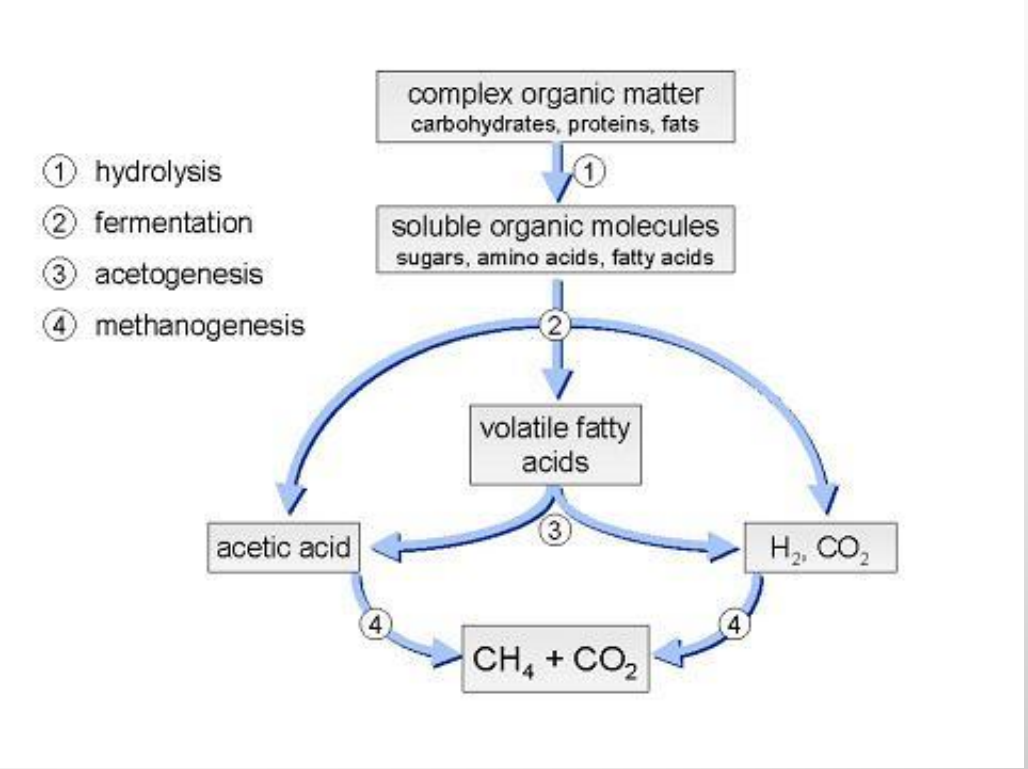
# Summary of Problem

* 40-50 thousand tons of tomatoes are culled annually from 4 packing houses in Immokalee, FL
  * Culled tomatoes are diseased, misshapen, or otherwise unmarketable
  * Disposal includes spreading over fields to decompose
* These tomatoes are a potential energy source
* Use of culled tomatoes in anaerobic digesters could help reduce outside energy reliance

# Culled tomatoes being shipped to fields

# Possible Solution: Anaerobic Digestion

* Production of biogas ($CH_4$ and $CO_2$) from the degradation of organic material by microbes in the absence of oxygen
  * 4 stages
* Amount of biogas produced depends heavily on what the digester is fed
* Food waste is an ideal feedstock for anaerobic digesters



# Properties of Digestion

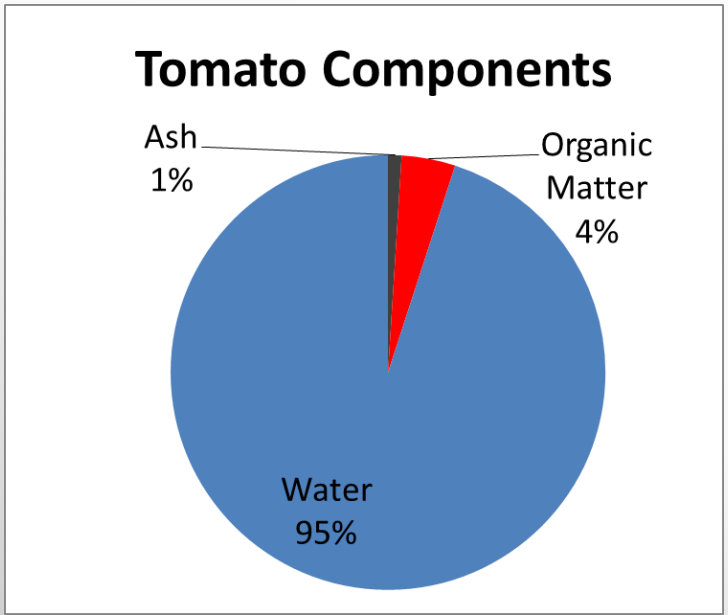
* pH
* Conductivity
* Total Solids/Volatile Solids (TS/VS)
* Chemical Oxygen Demand (COD)
* Biomethane Potential (BMP)

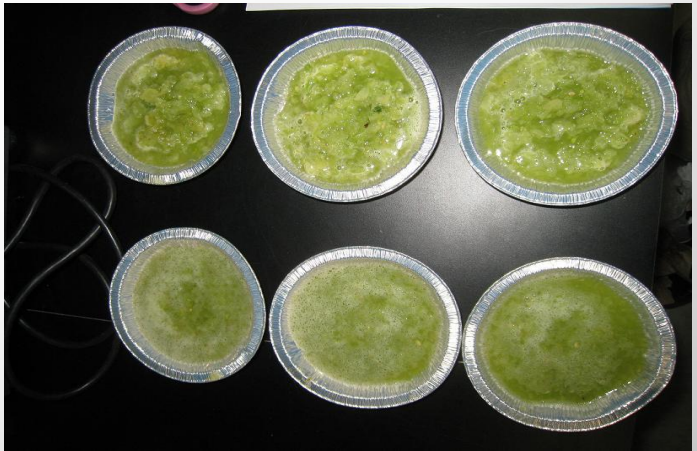
# Properties of Digestion

* pH is acidic, range is around 4.5 ± .2
* Conductivity of tomatoes ranged around 6 mS/cm
* Tomato juice had up to 6.74 mS/cm

# Properties of Digestion

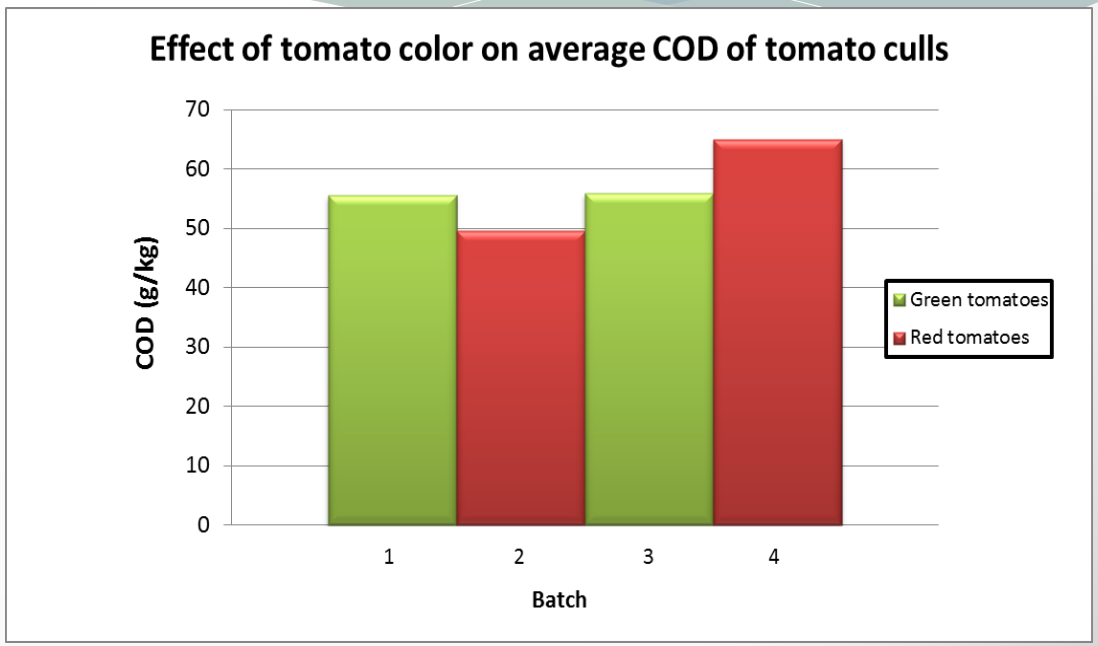
* Total Solids/Volatile Solids (TS/VS)
* Total Solids ~ 5.35%
* TS/VS Ratio ~ 80%



# Properties of Digestion

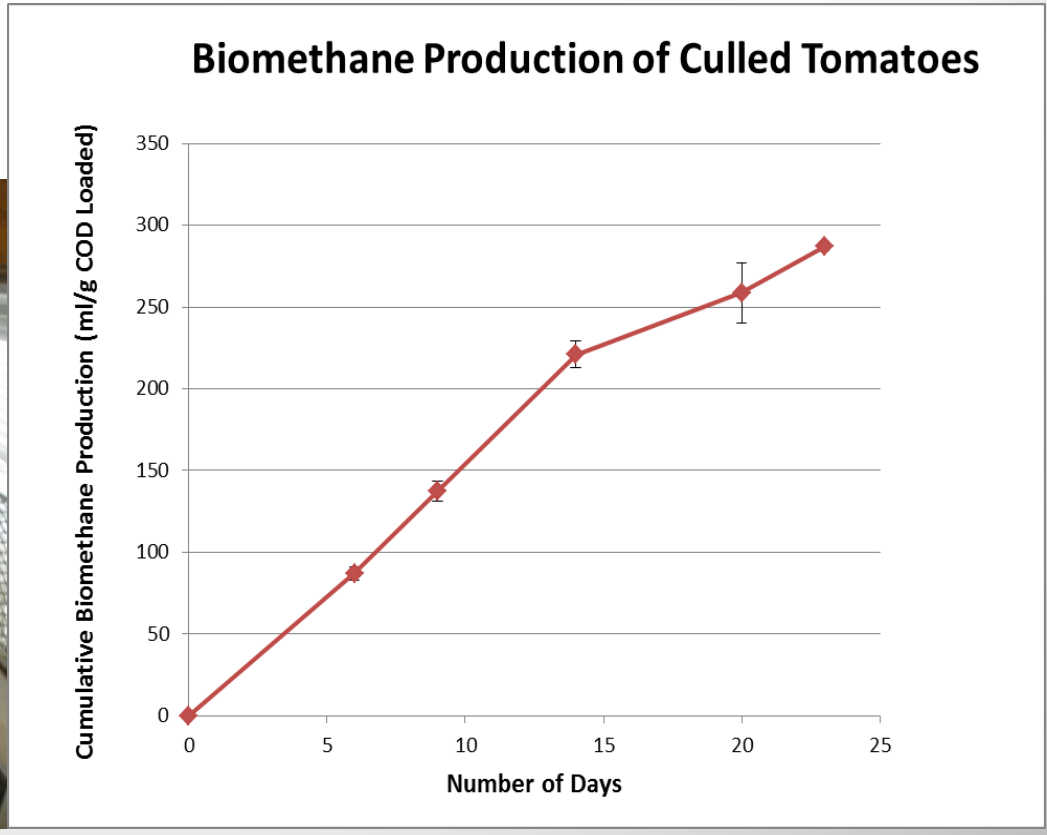
* Chemical Oxygen Demand (COD)
  * Color of tomatoes does not have an effect on COD
  * COD is higher in the pulp, but microbes consume the soluble juice more readily
  * COD of pulp is around 120 g/kg
  * COD of juice is around 48 g/kg




| | % by weight | COD | % Total COD |
|---|---|---|---|
| Tomato Juice | 78.6 | 48 | 59.5 |
| Tomato Pulp | 21.4 | 120 | 40.5 |

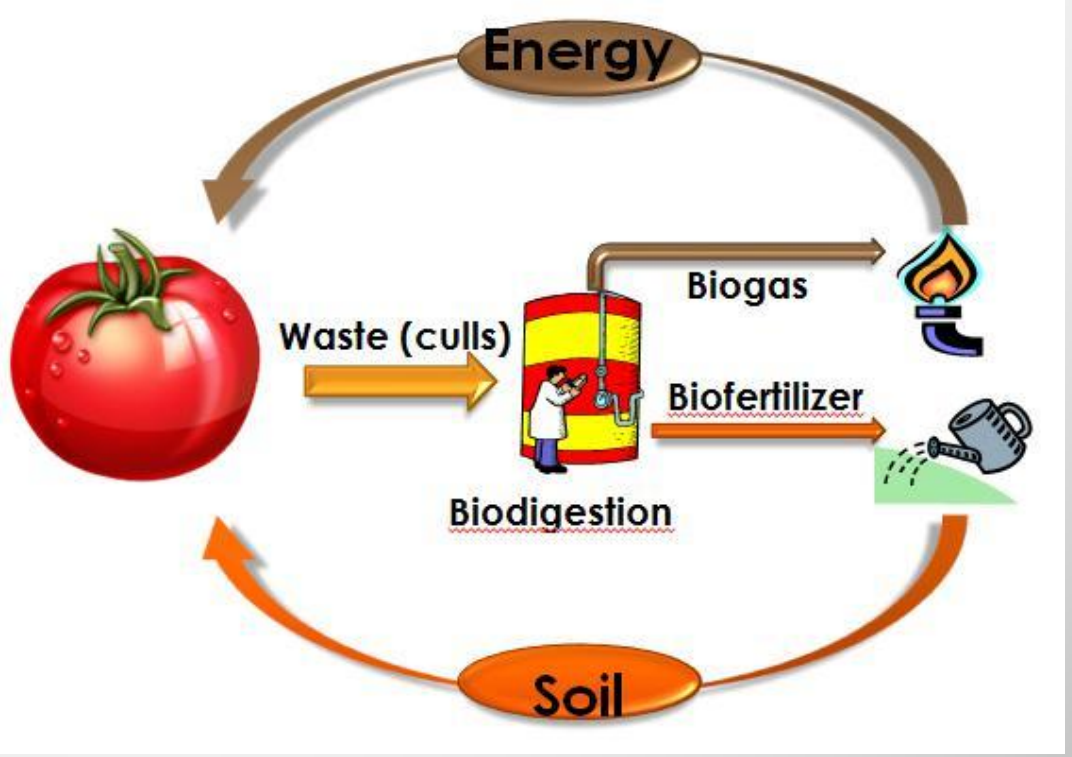
# Properties of Digestion

* Biomethane Potential (BMP)
* Loaded at 2g COD/L
* 287 ml/g COD Loaded at day 23



# Summary of Properties of Digestion

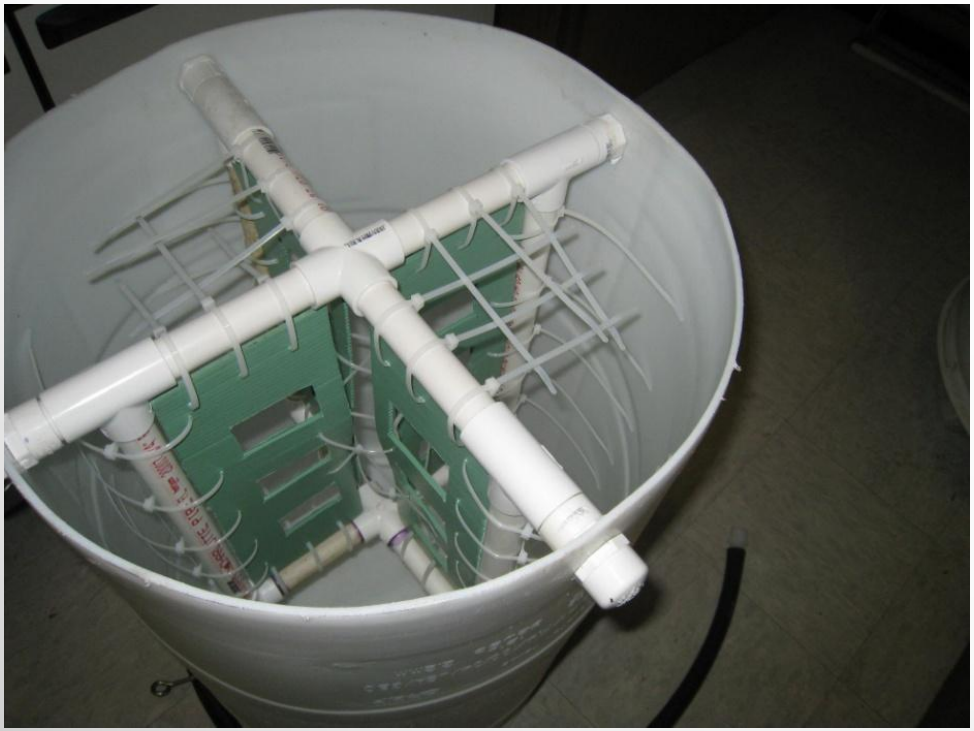
* pH is acidic
  * Monitoring the digester is necessary to prevent acidification
* Tomatoes are approximately 78.6% juice and 21.4% pulp
* The soluble juice is the most readily available portion of the tomato for the microbes
* 60% of the tomato is readily available for microbial uptake while 40% will undergo hydrolysis over time before becoming available
* Digestate is a possible fertilizer



# Anaerobic Digester

* Easy and cheap to build
* Simple stirring system
  * Large surface area for microbial colonies

# Anaerobic Digester



# Anaerobic Digester

# Results

* Feasible for use in an anaerobic digester
* Convenient for tomato packing houses
  * Centralized location
* Beneficial both economically and environmentally
* Helps to achieve ultimate goal of sustainability

# Future Studies

- Continue monitoring digester
- Determine optimum loading rate
- Research into changing operating conditions
  - Pulp vs juice
  - Different inocula
    - Manure, hydric soil methanogens
- Use of tomato digestate as fertilizer

# Questions/Comments

Thank You