Co-digestion of Used Cotton Clothing

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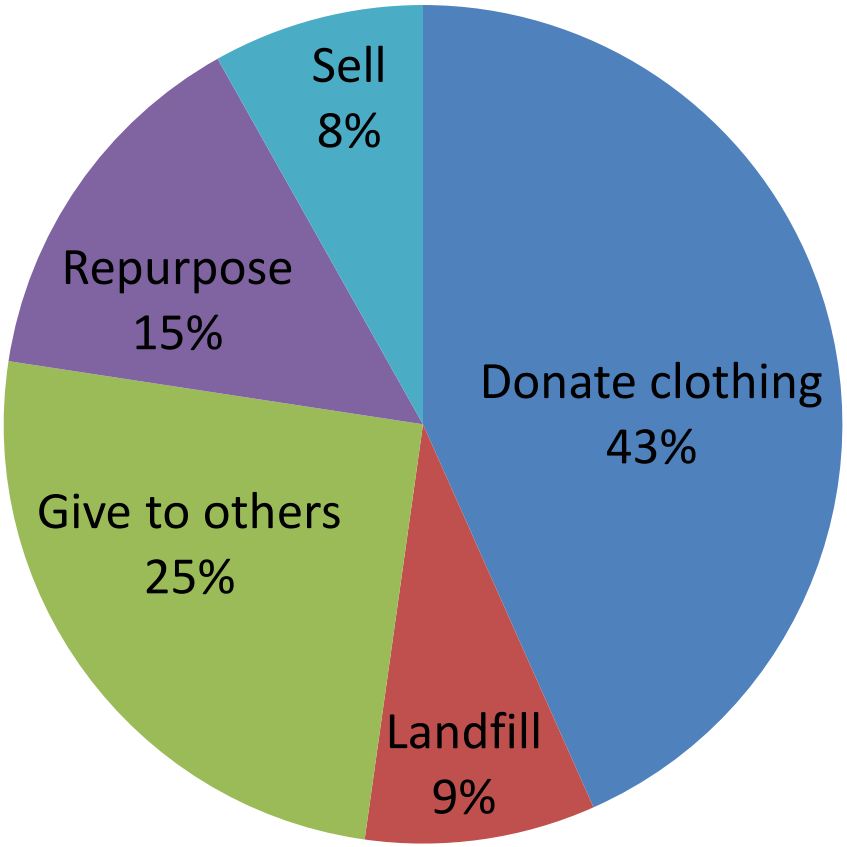
Summary of Problem

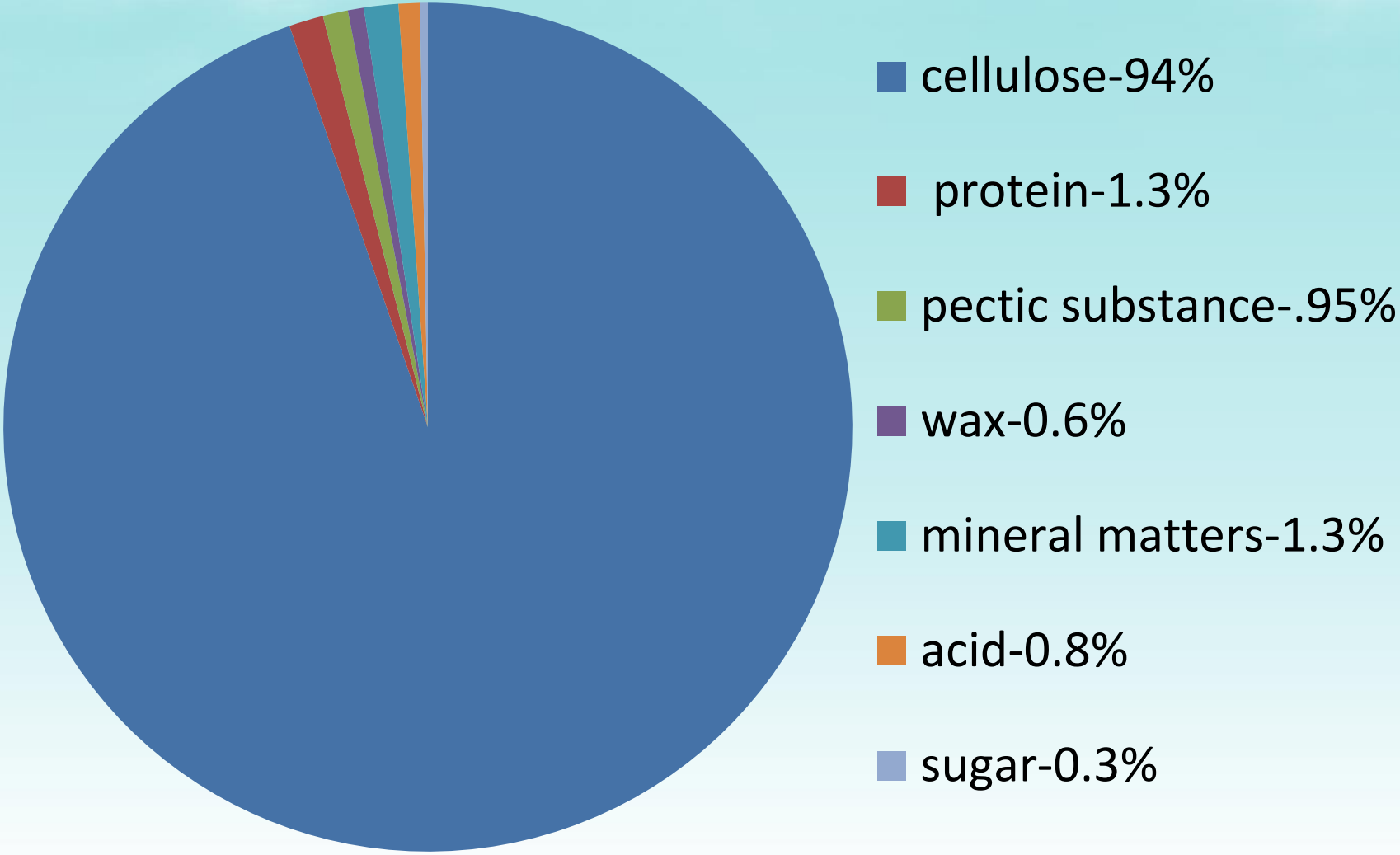
- Used cotton clothing commonly sent to landfill
- Wasted energy source
  - ~90% cellulose
- Possibility of anaerobically digesting discarded clothing

Survey on the Disposal of Used Clothing

N=130



Composition of Cotton



Cellulose

- Cellulose

  -Hard to break down

  -Hydrolysis limited

- Need for pretreatment!

Objectives

- Assess biodegradability of cotton fabric by using cellulase enzyme
- Test if cotton fabric can produce biogas using co-digestion in a Biomethane Potential Assay

Assessment of Cotton Fabric Biodegradability

- Test biodegradability

  -Factory enzyme *Kerry Biocellulase*
- Compare biodegradability

  -Filter Paper (control)

  -Cotton T-shirt

  -Biocellulase (blank)

Methods

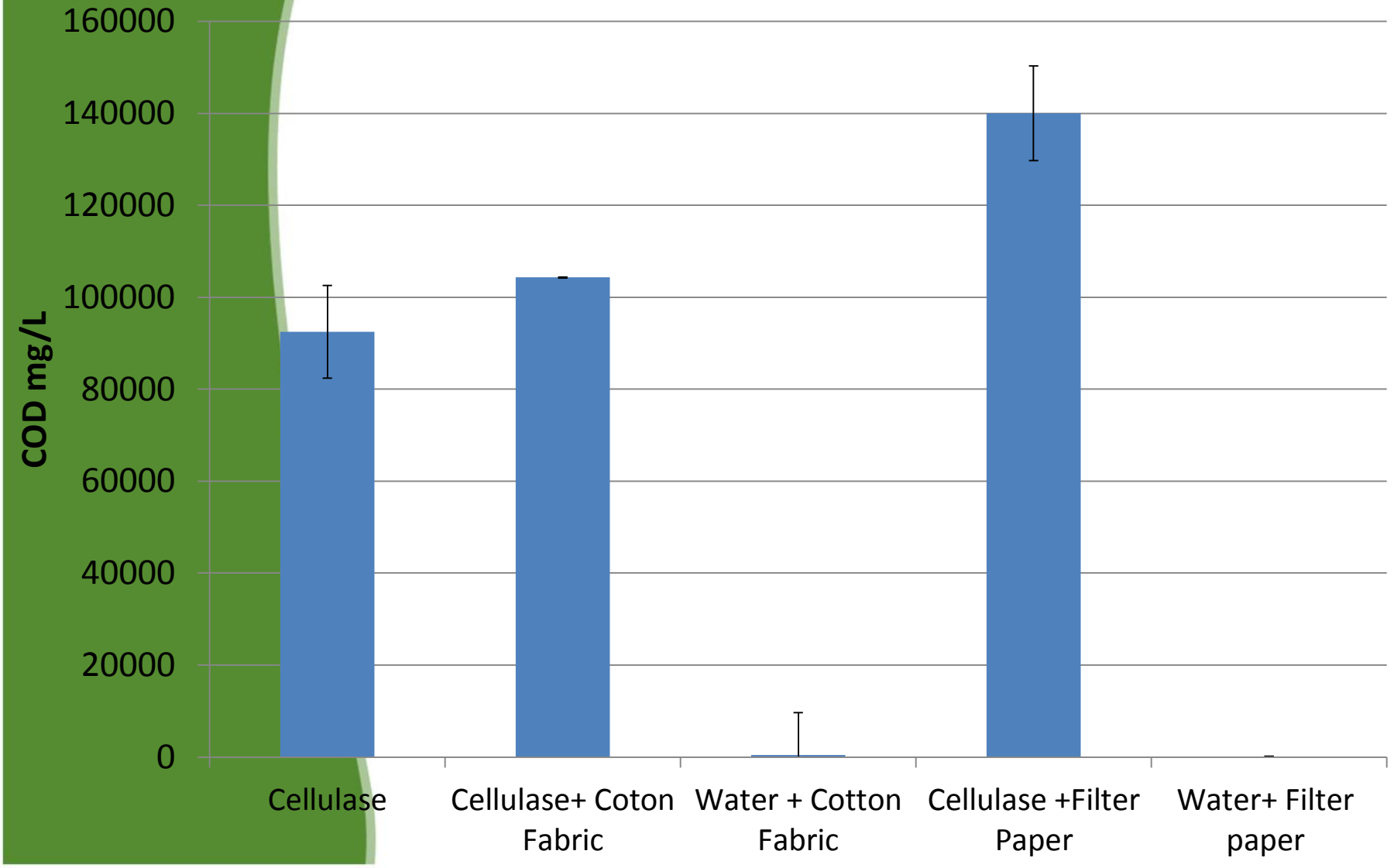
- Microscopic examination of sample before and after
- Chemical Oxygen Demand (COD_T)= indirectly measures organic material
  - measured liquid portion
- Soluble Chemical Oxygen Demand (COD_s)= measures dissolved organic material

Effect of Treatment with Cellulase

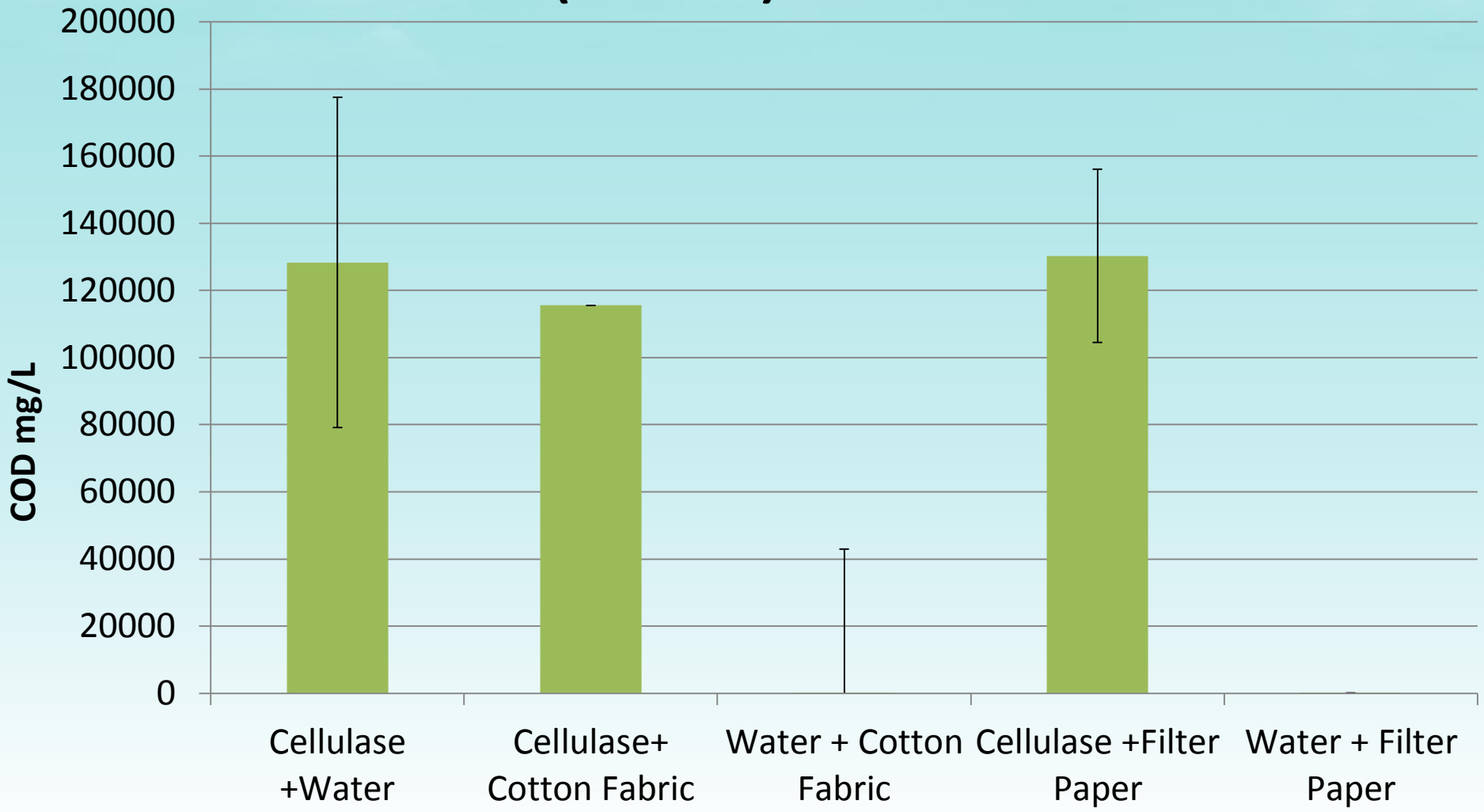
Before

After

Total Chemical Oxygen Demand (COD_T)



Soluble Chemical Oxygen Demand (COD_S)



Downside of Factory Cellulases

- Very expensive!
- Need a lot to be fully effective
- Possible Solutions: natural enzymes

  - Food waste

Possible Solution: Co-digestion with Food Waste

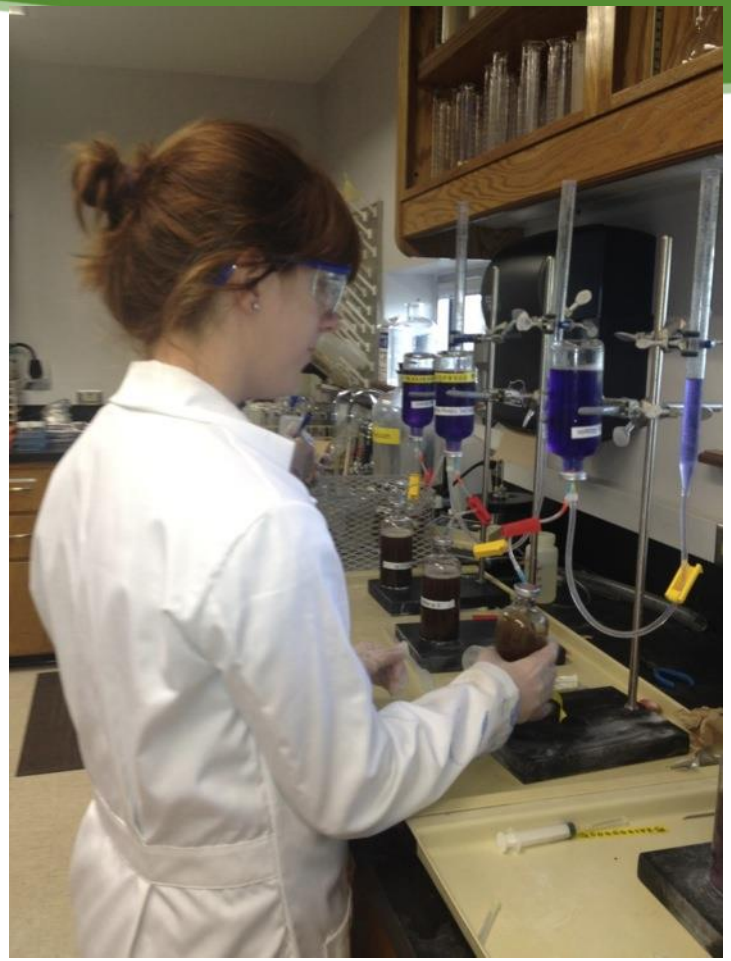
- Food waste is an efficient feedstock
- Food waste has low C: high N →quickly acidifies →inhibition
- Cotton has high C: low N → longer to produce methane
- Both feedstocks balance each other out

Possible need for Different Temperatures

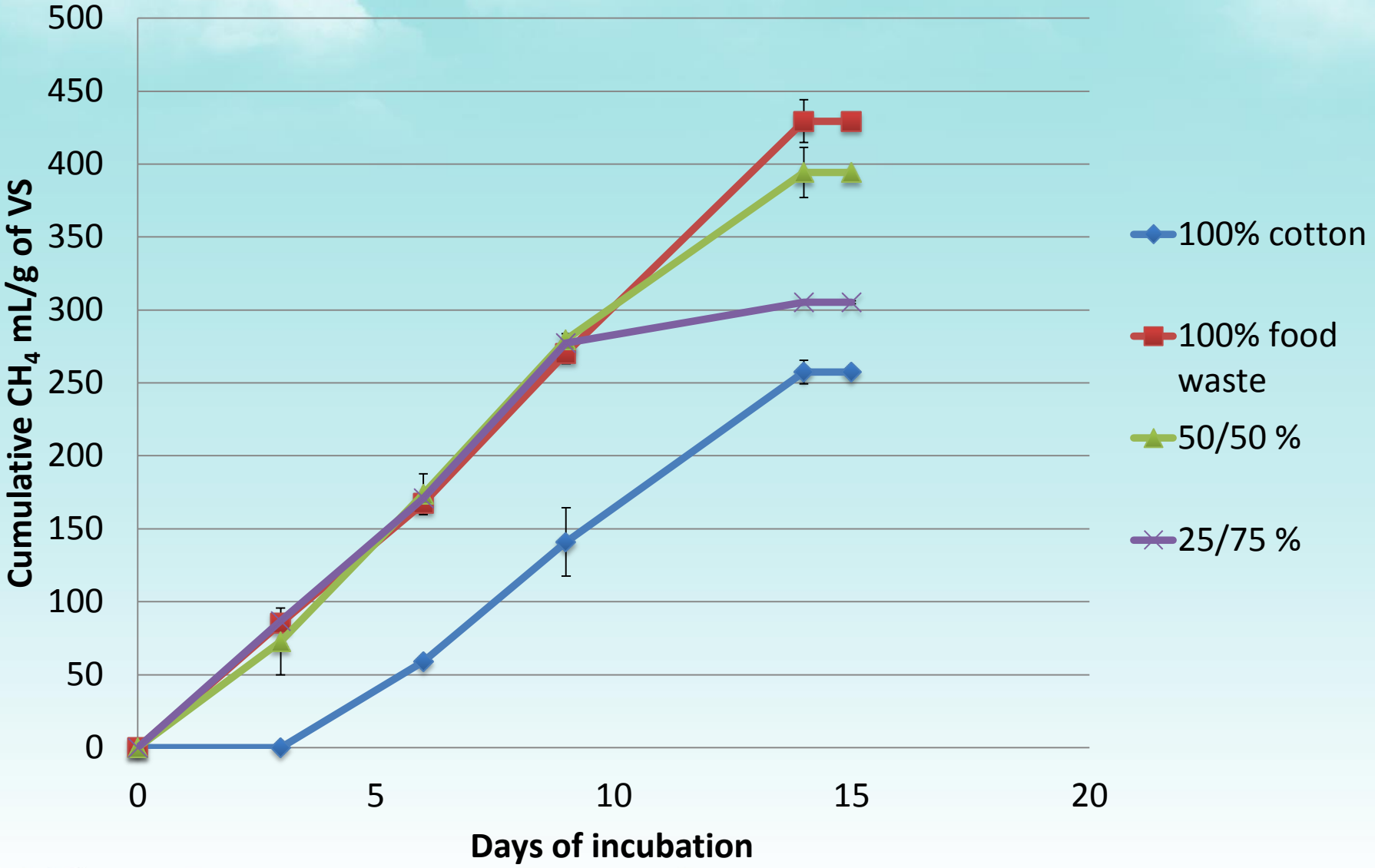
- Different enzymes have different optimal temperatures
- *Kerry Biocellulase*= 55 °C
- Food Waste BMP= 35 °C
- 35, 45, 55 °C

Measurement

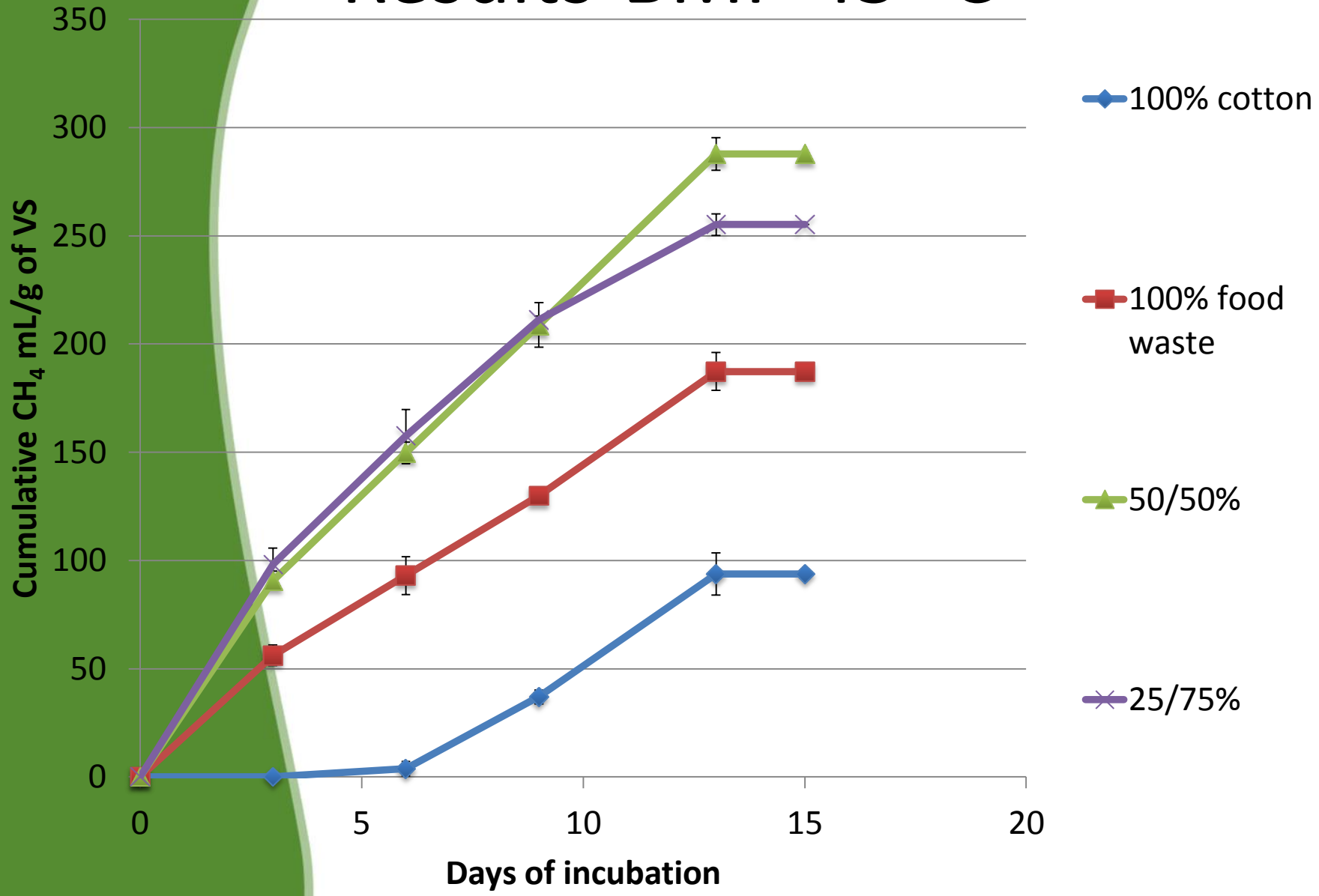
- Tested by measuring Biochemical Methane Potential (BMP)
  - -100% Cotton T-Shirt (TS)
  - -100% Food Waste (FW)
  - -50% Cotton TS, 50% FW
  - -25% Cotton TS, 75% FW
  - -Blank



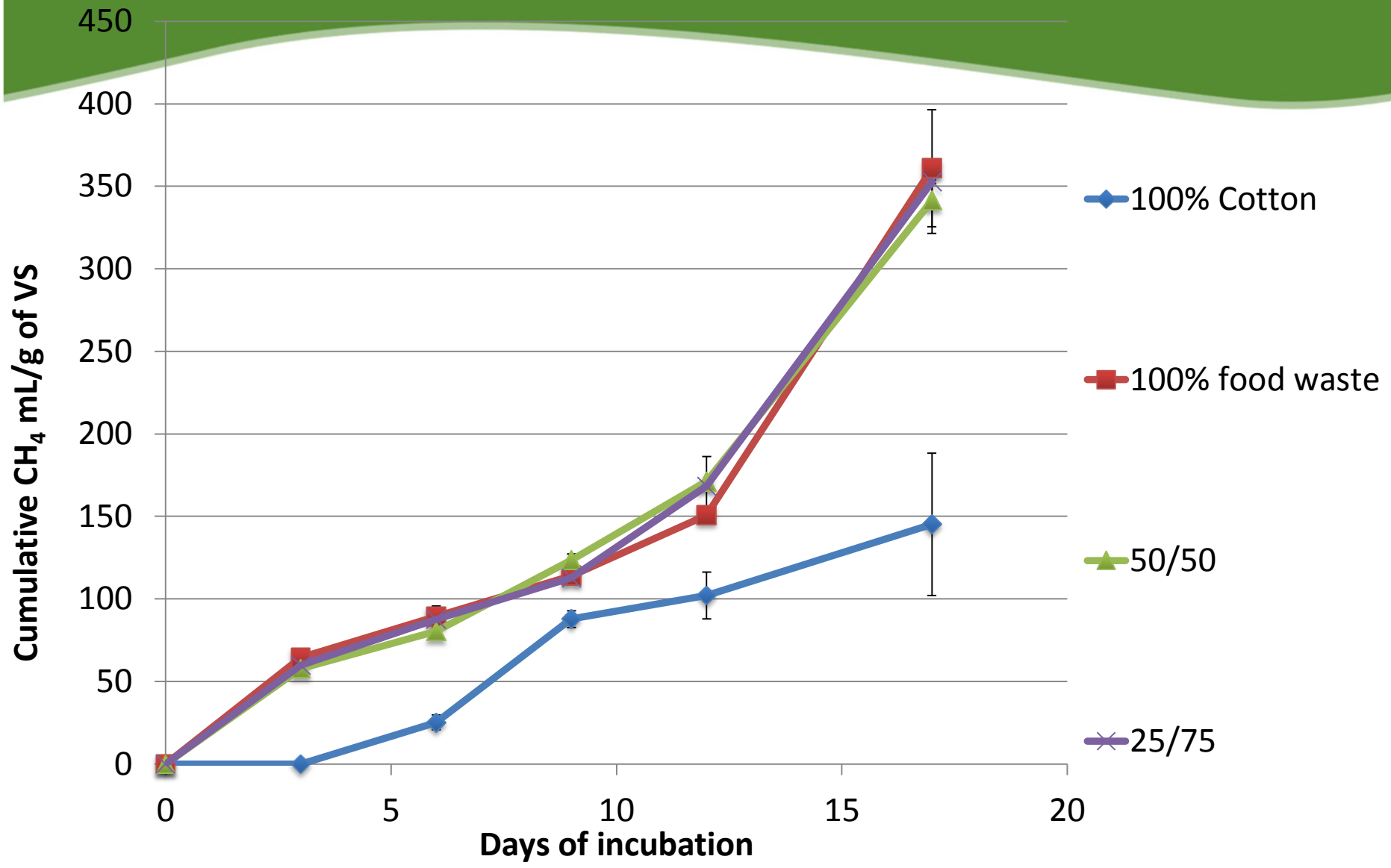
Results-BMP 35 °C



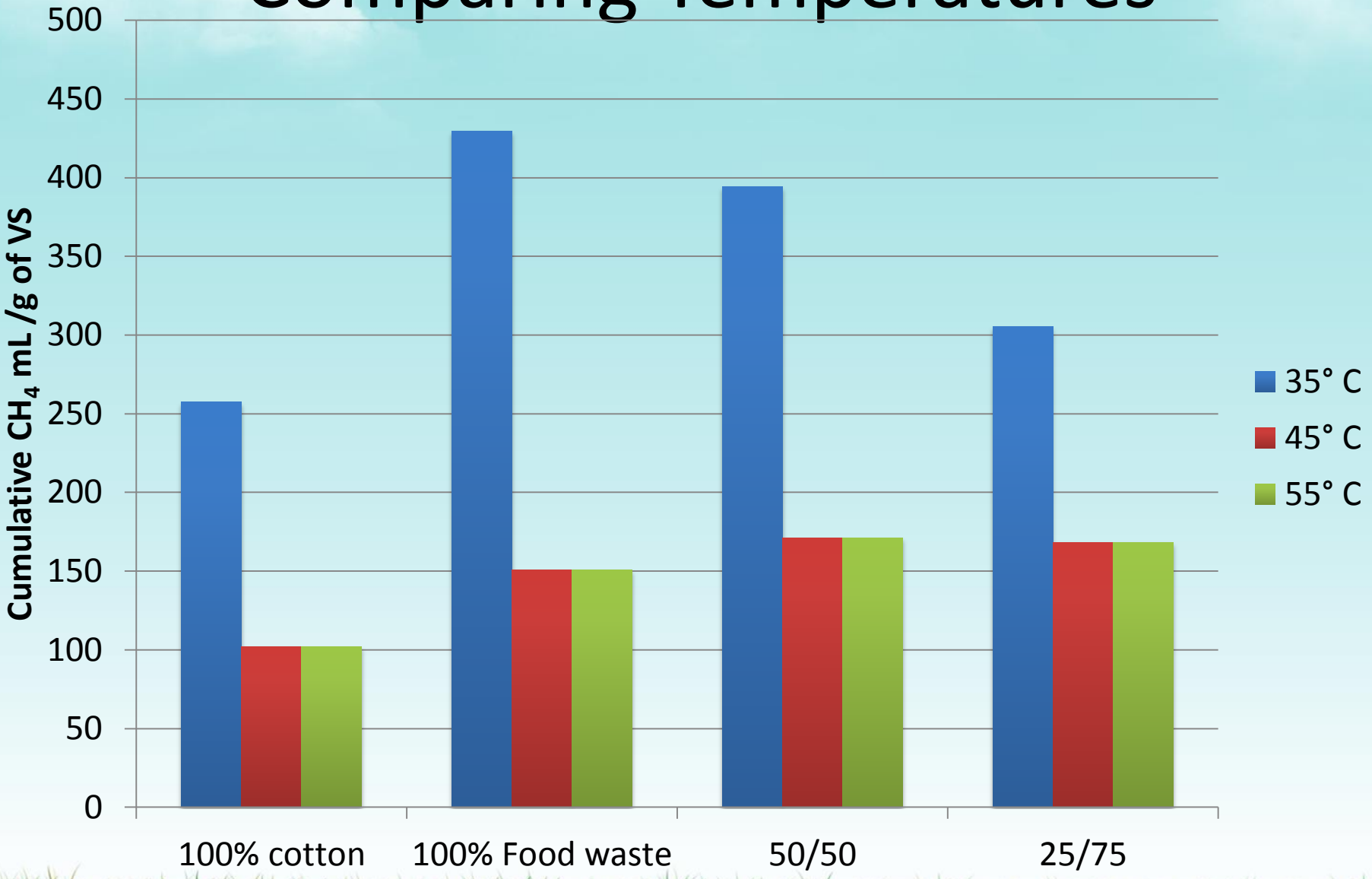
Results-BMP 45 °C



Results-BMP 55 °C



Comparing Temperatures



Conclusion

- Cotton clothing can be a feedstock for anaerobic digestion
- Food waste aids clothing in methane production and vice versa
- 35°C is most efficient temperature with the tested inoculum

Future Studies

- Test for any other possible natural pretreatments

  -septic system treatment

  -natural digestion enzymes
- Create digester with food waste and used clothing
- Test if effluent is efficient fertilizer
- Test effects of dyes and detergents

Thank you!

Questions or Comments?