

## The Big Picture

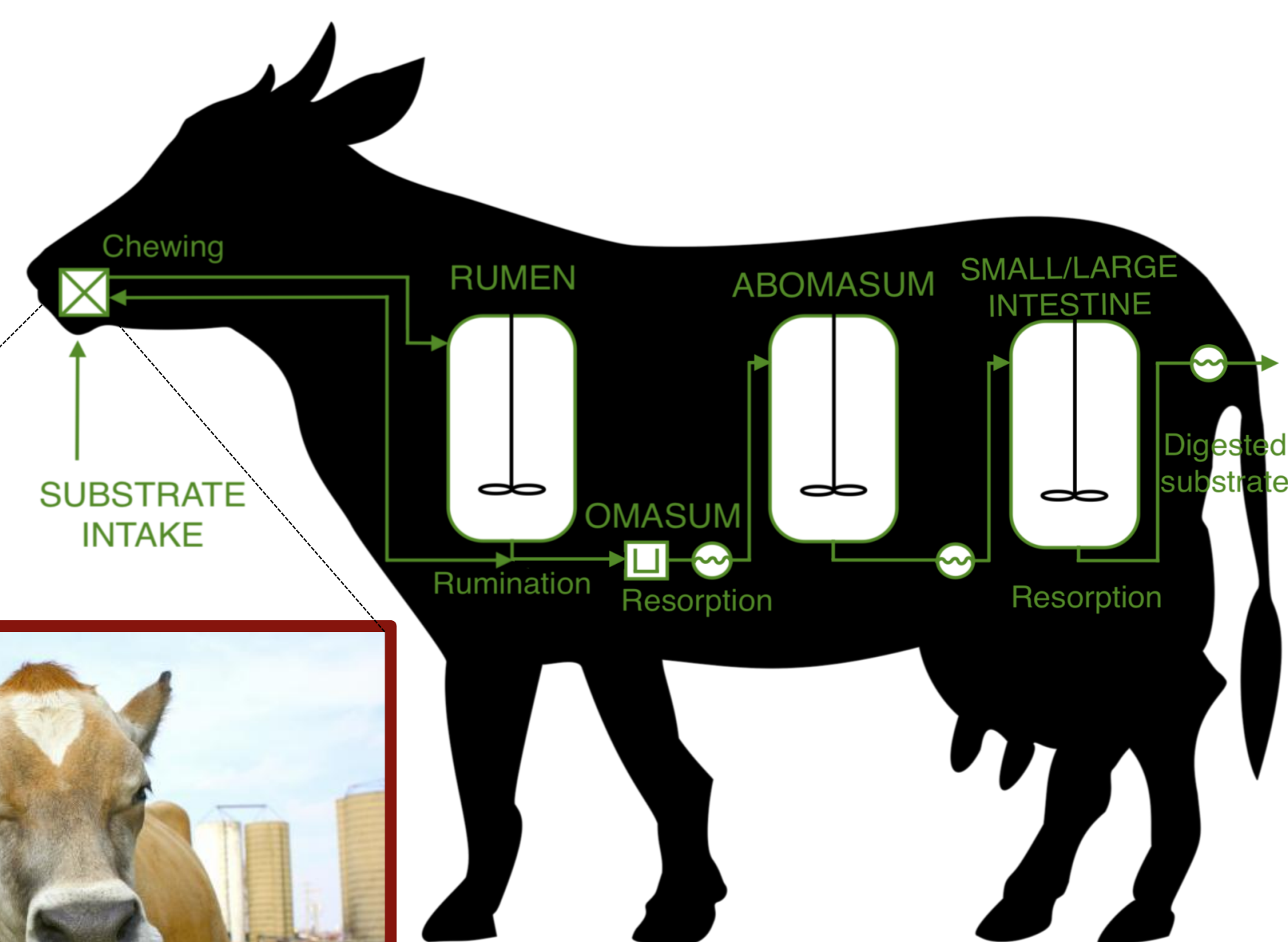
- To enable the utilization of lignocellulosic (plant) biomass for the production of biofuels and biochemicals more efficiently by enhancing their digestion in fermentation reactors
- The recalcitrance of lignocellulose has given rise to mechanical, chemical, and biological pretreatment strategies for more complete utilization
- Here, “Cotreatment” is introduced as an alternative strategy and has been successfully demonstrated in pure culture systems (Paye et al., 2016, Balch et al., 2017)

## Key Processes

**Anaerobic digestion** is the breakdown of biological material into organic acids and subsequently into biogas by mixed microbial cultures.

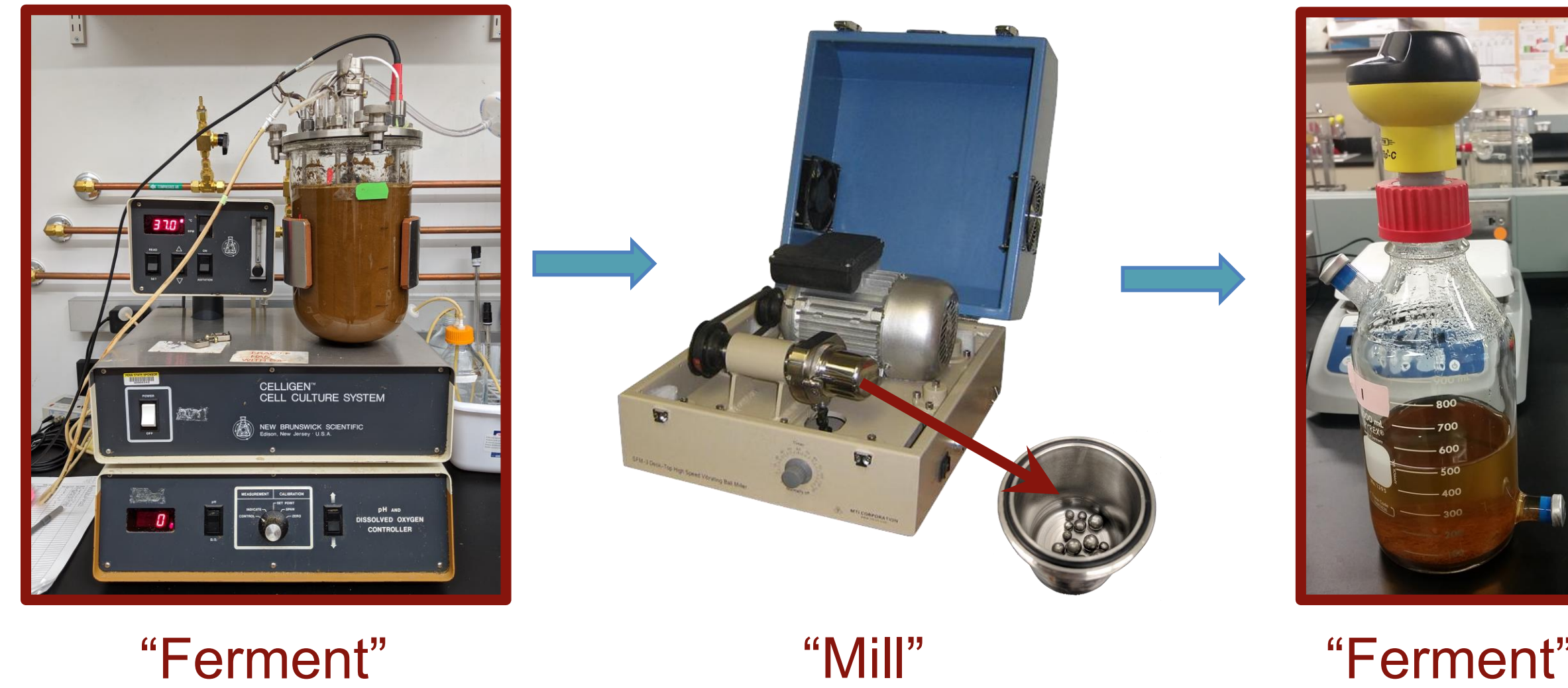
**Anaerobic microbiomes** are mixed culture microbial populations that work together to degrade the lignocellulosic biomass under anaerobic conditions.

**Cotreatment** is the process of mechanically disrupting plant biomass mid-fermentation to improve its digestibility. It is based on the “chewing of cud” process by ruminants.

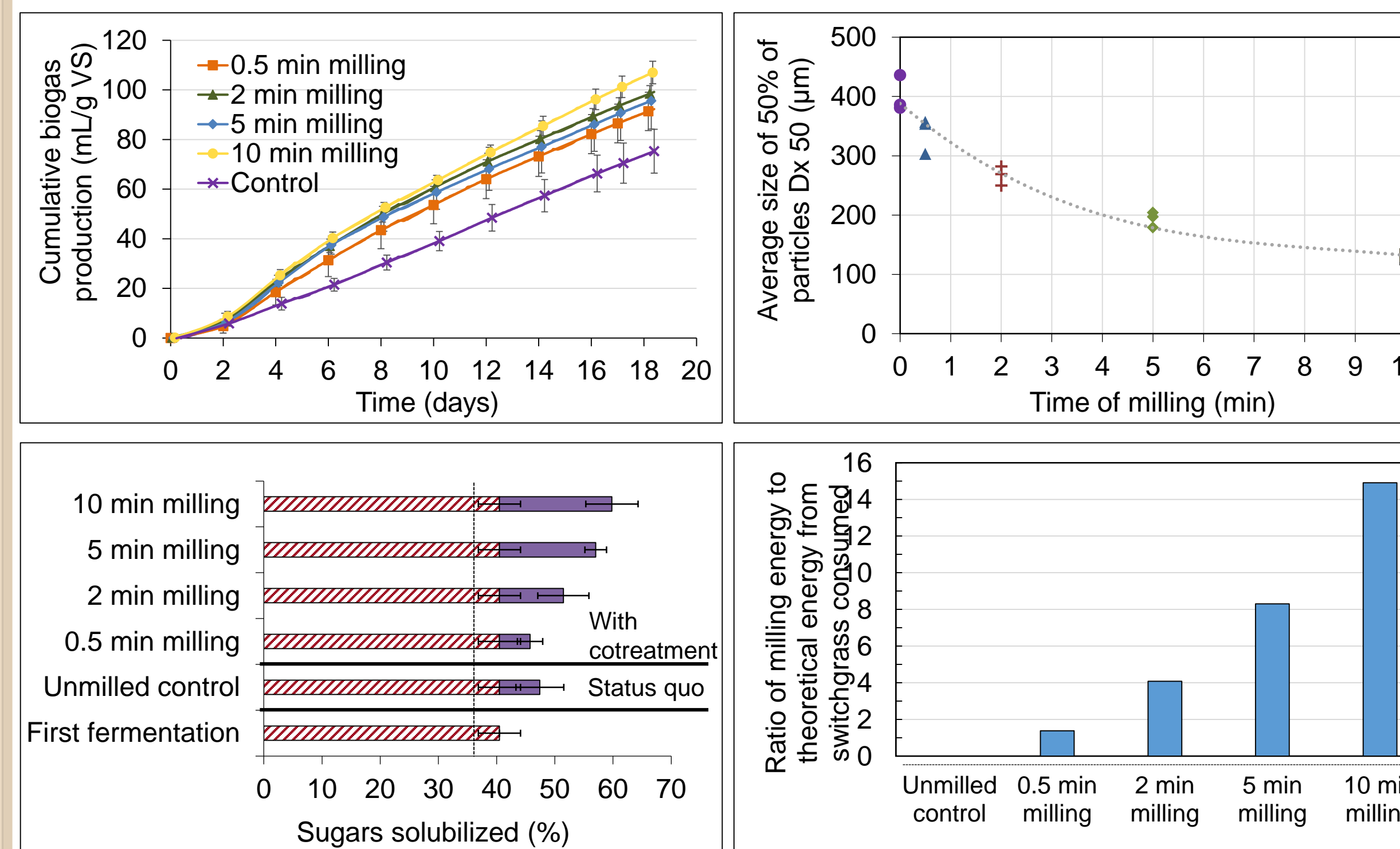


Envisioning ruminants as bioreactors with alternating milling and fermentation through “chewing of the cud”

## Single stage cotreatment

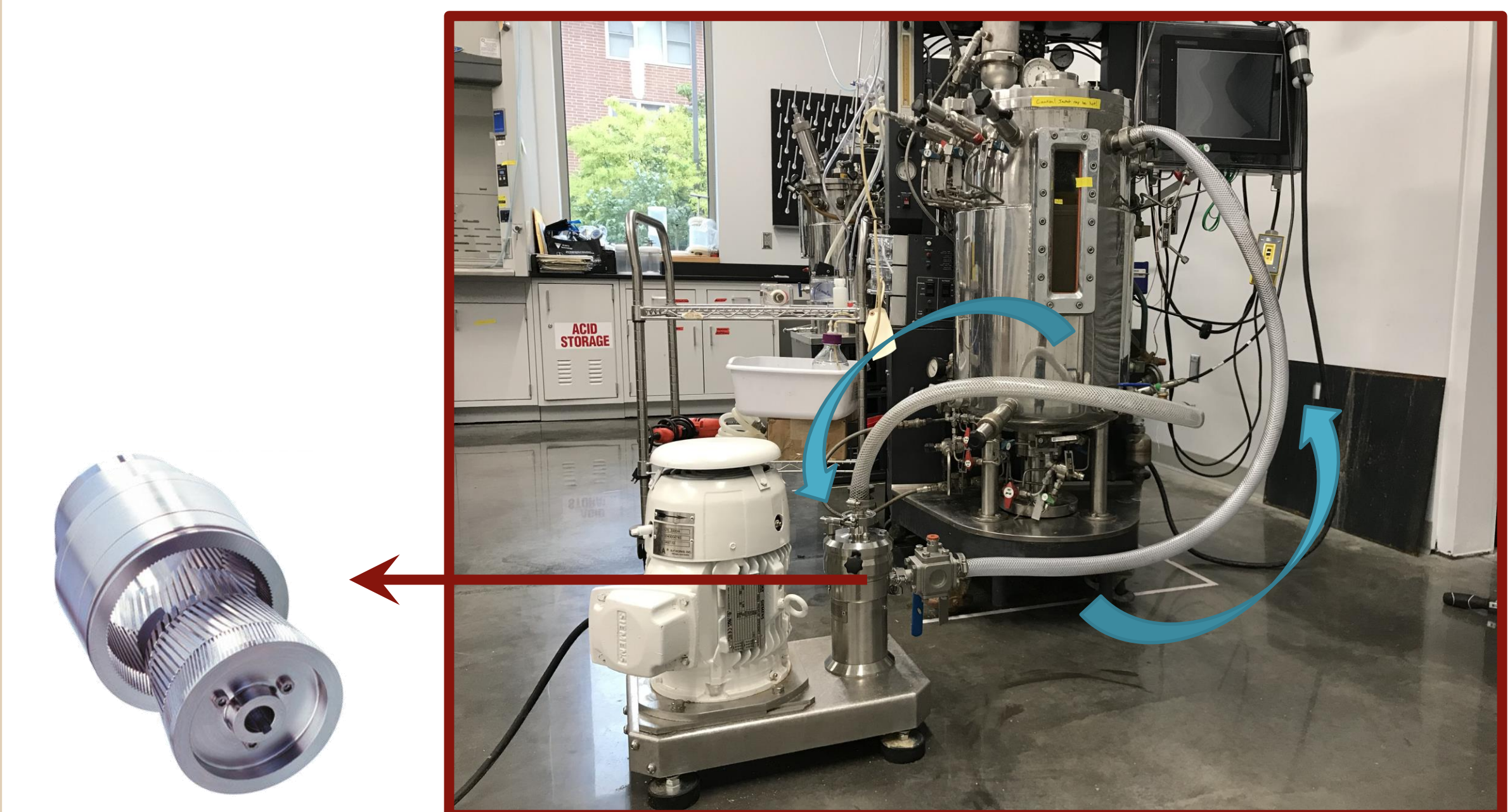


- Fermentation 1:** 6% senescent switchgrass digested semi-continuously at 37 °C and pH 7 with a retention time of 30 days
- Milling:** Ball mill with different milling times of 0, 0.5, 2, 5 and 10 minutes respectively
- Fermentation 2:** Second fermentation post-milling conducted in batch mode for 18 days



## Intermittent Recirculatory Cotreatment

- The bioreactor and IKA colloid mill system are operated semi-continuously and arranged in a loop to allow for intermittent recirculation
- Repeated mechanical milling events could cause changes in the microbiome due to differential tolerance to the cotreatment process
- Enrichment of stress tolerant community members over time could increase the efficiency of biogas production
- Samples will be collected to complete gas production and compositional, metagenomic, transcriptomic, and metabolomic analyses



IKA LaborPilot colloid mill and a close-up of its milling head. The mill is attached to an 80L anaerobic digestion reactor with a recirculation loop.

## In the works...

- Developing energy efficient and cost effective milling strategies – colloid mill
- Determining the impacts of mechanical milling on anaerobic microbiome
- Improving the reliability of mechanisms for anaerobic volume milling exchange
- Establishing practices for effective suspension and conveyance of biomass slurries

## References

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