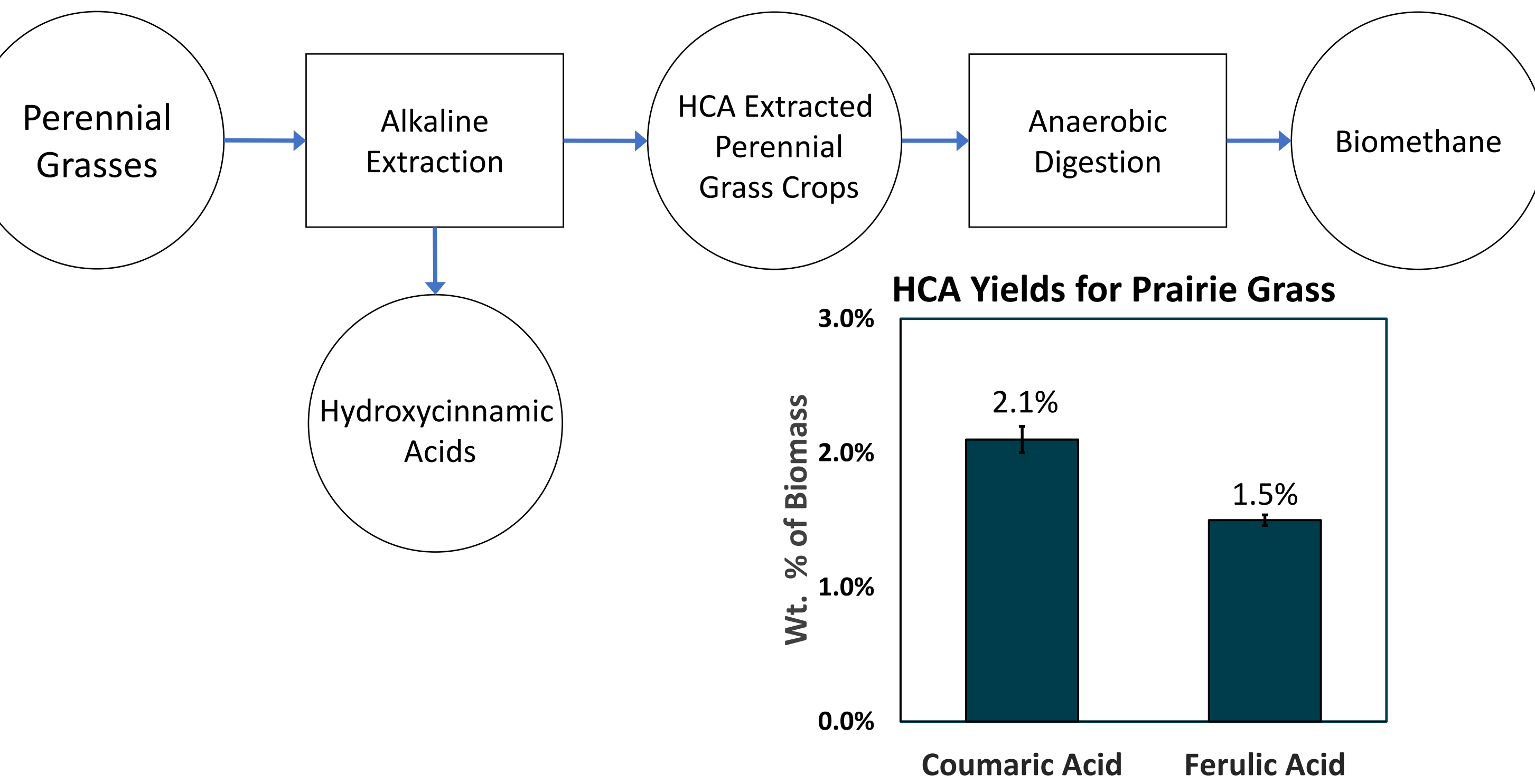


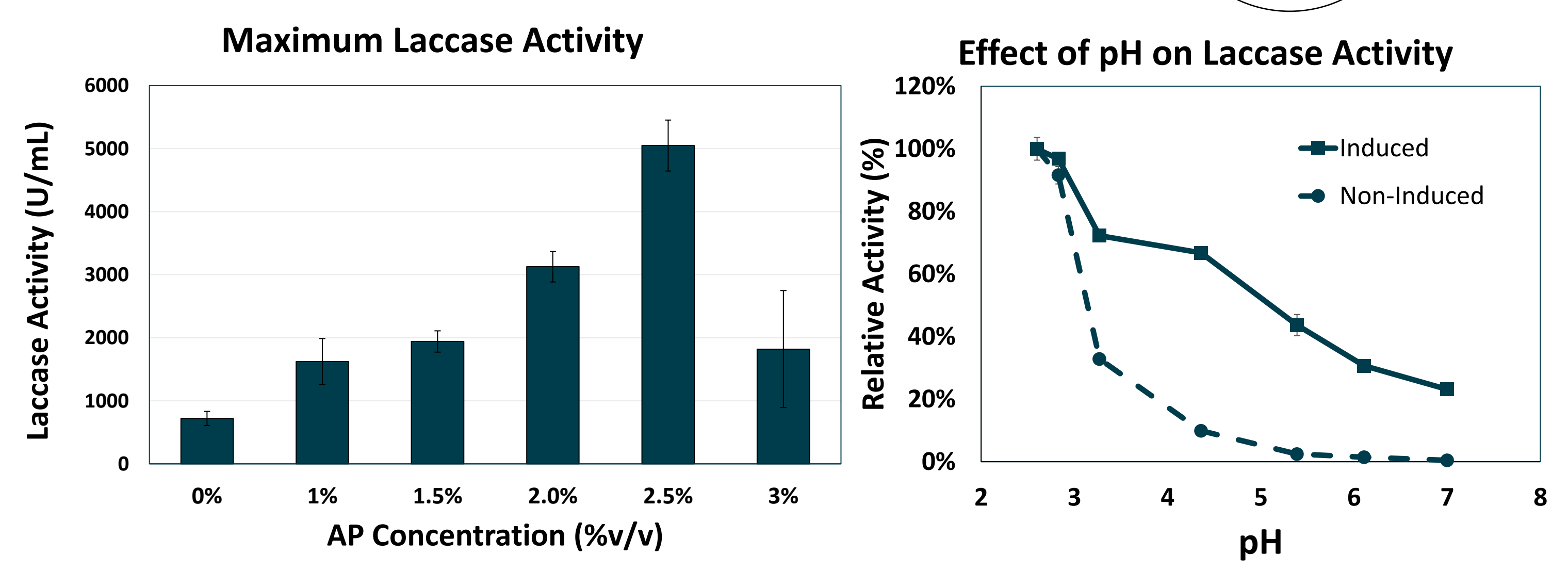
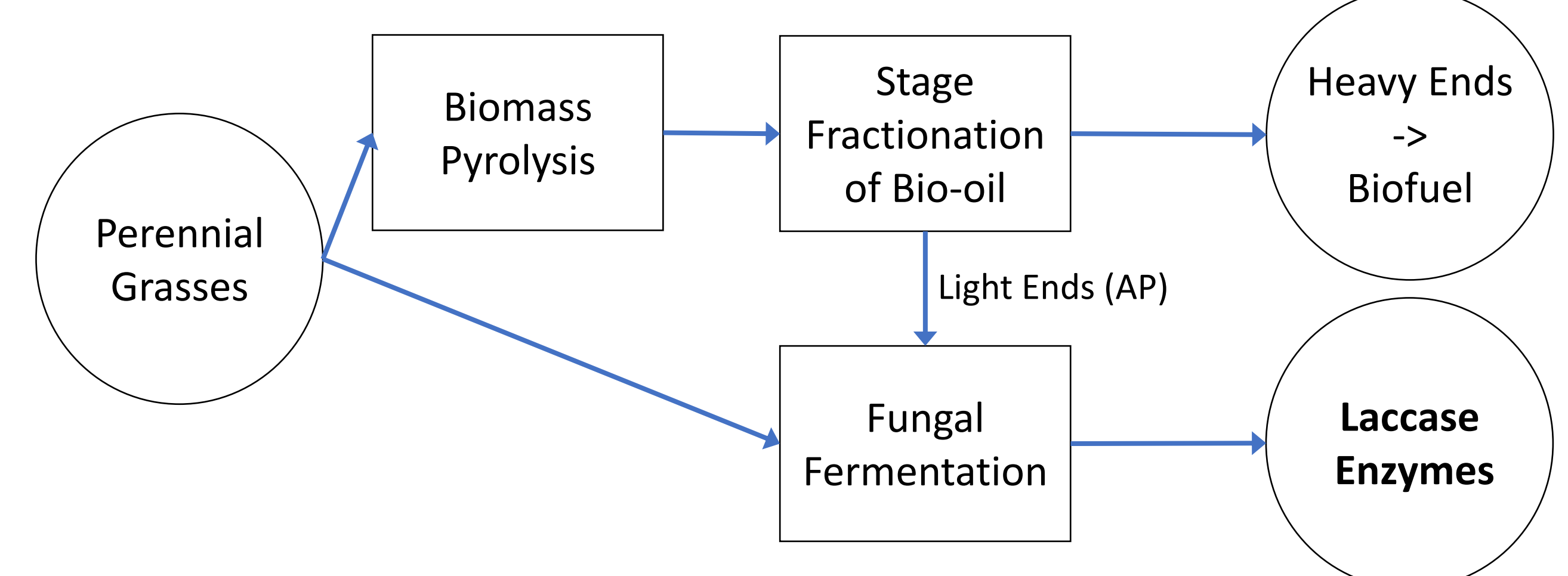
HCA-Extraction of Biomass

- Mild alkaline treatment that simultaneously delignifies biomass and extracts high-value coproducts in the form of hydroxycinnamic acids (HCA).
- Originally developed at Iowa State University for pretreatment of corn stover to produce cellulosic ethanol.
- Published TEA results show significant improvements in economics of a cellulosic ethanol plant due to HCA-extraction.



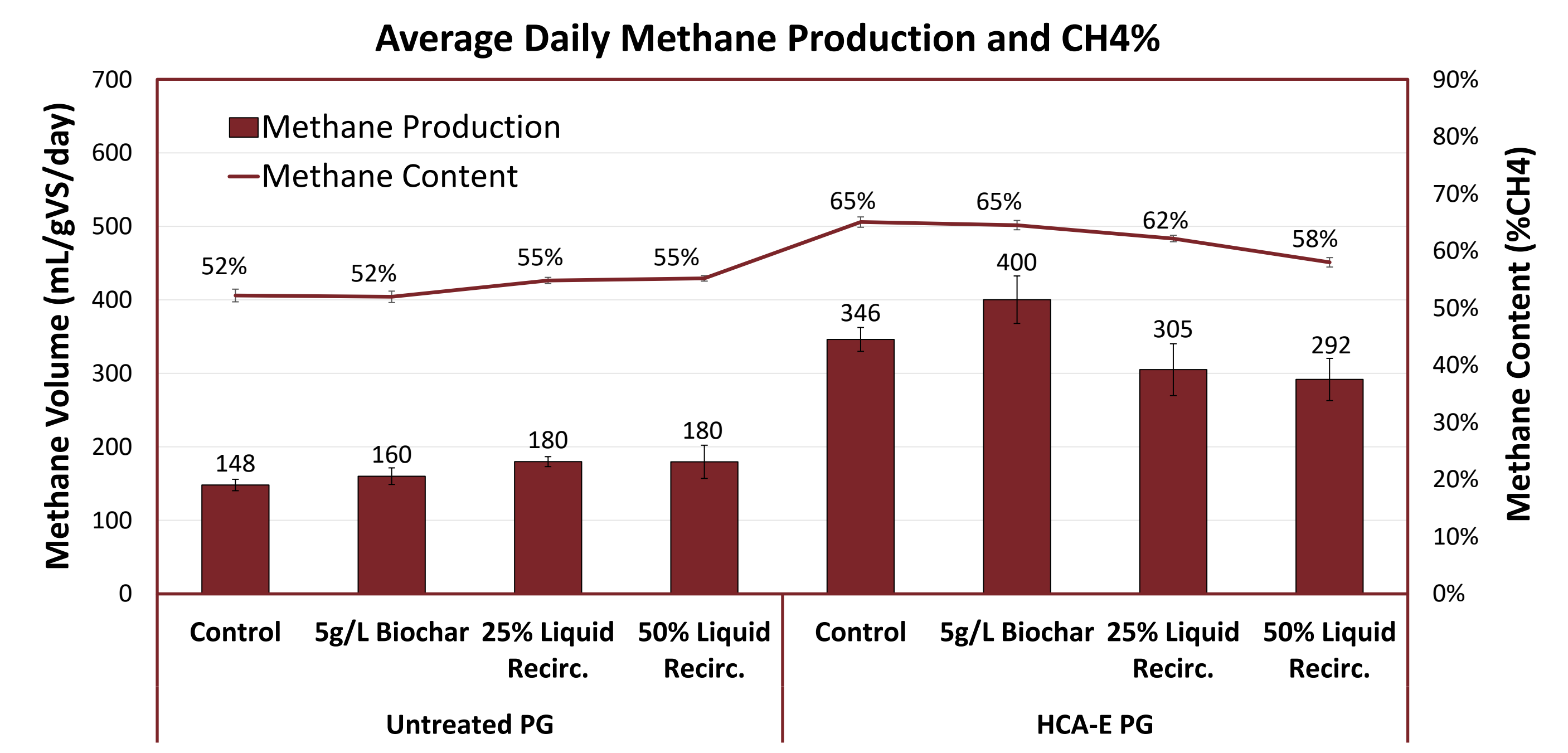
Laccase Production from Pyrolysis Light-Ends

- Pyrolysis light-ends are the separated aqueous phase (AP) from bio-oil; containing low molecular weight phenolics and carboxylic acids.
- AP has little value, as its toxicity makes it difficult for bioprocessing.
- Laccase are versatile enzymes, well-known for their role in bioremediation and lignin modification.
- My research has discovered that AP is capable of inducing laccase production from white-rot fungi, with high yields and improved pH stability.



HCA-Extraction for Anaerobic Digestion

- HCA-extraction was evaluated in the continuous codigestion of prairie grass and manure.
- HCA-extraction resulted in 133% higher methane production and improved biogas quality.
- Biochar pairs well with HCA-extracted grass, while liquid recirculation pairs well with untreated grass.

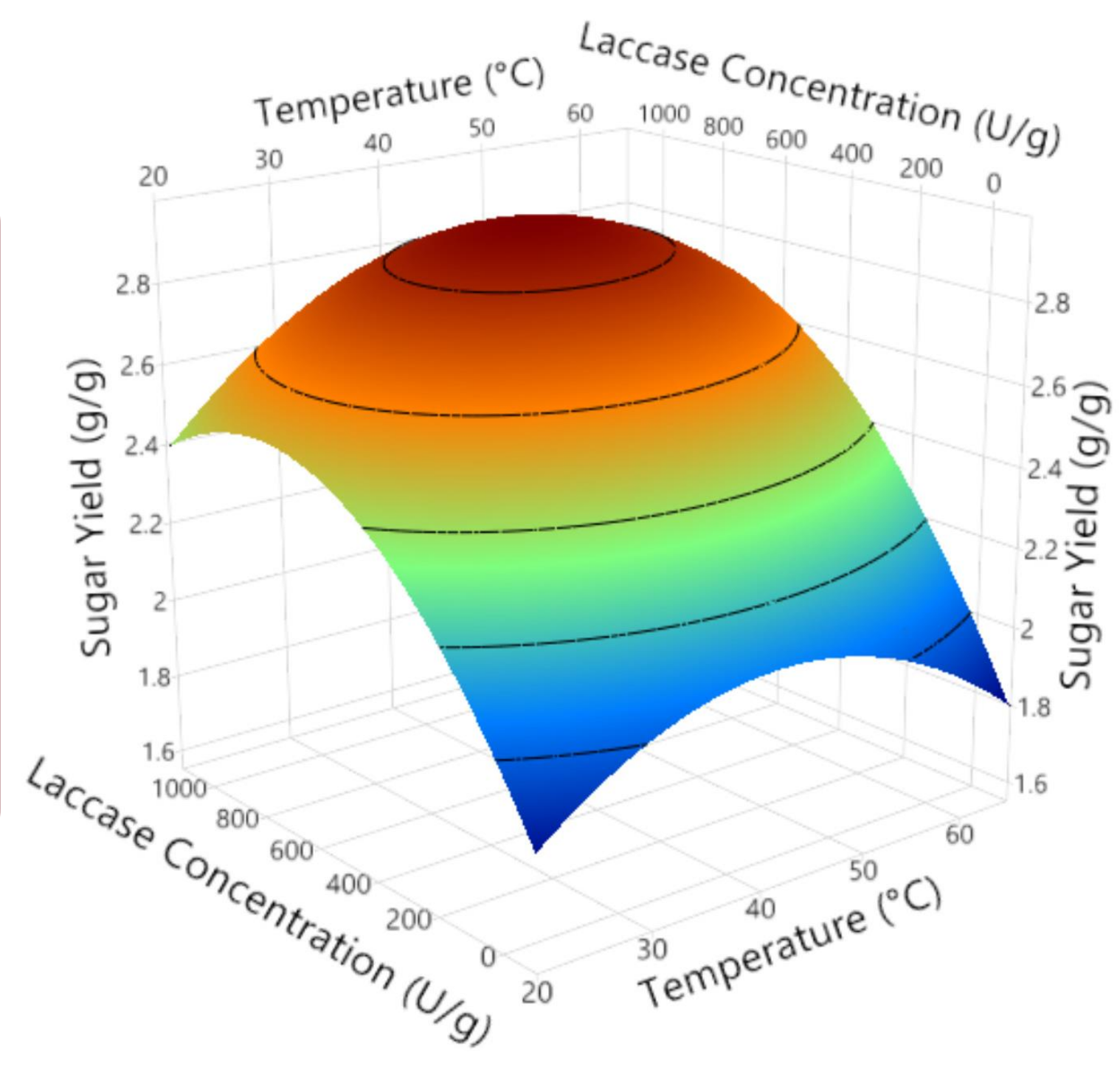


Future Prospective

- Manuscript for this work is currently in review.
- Collaborating with ISU research group to conduct techno-economic and life cycle analysis.

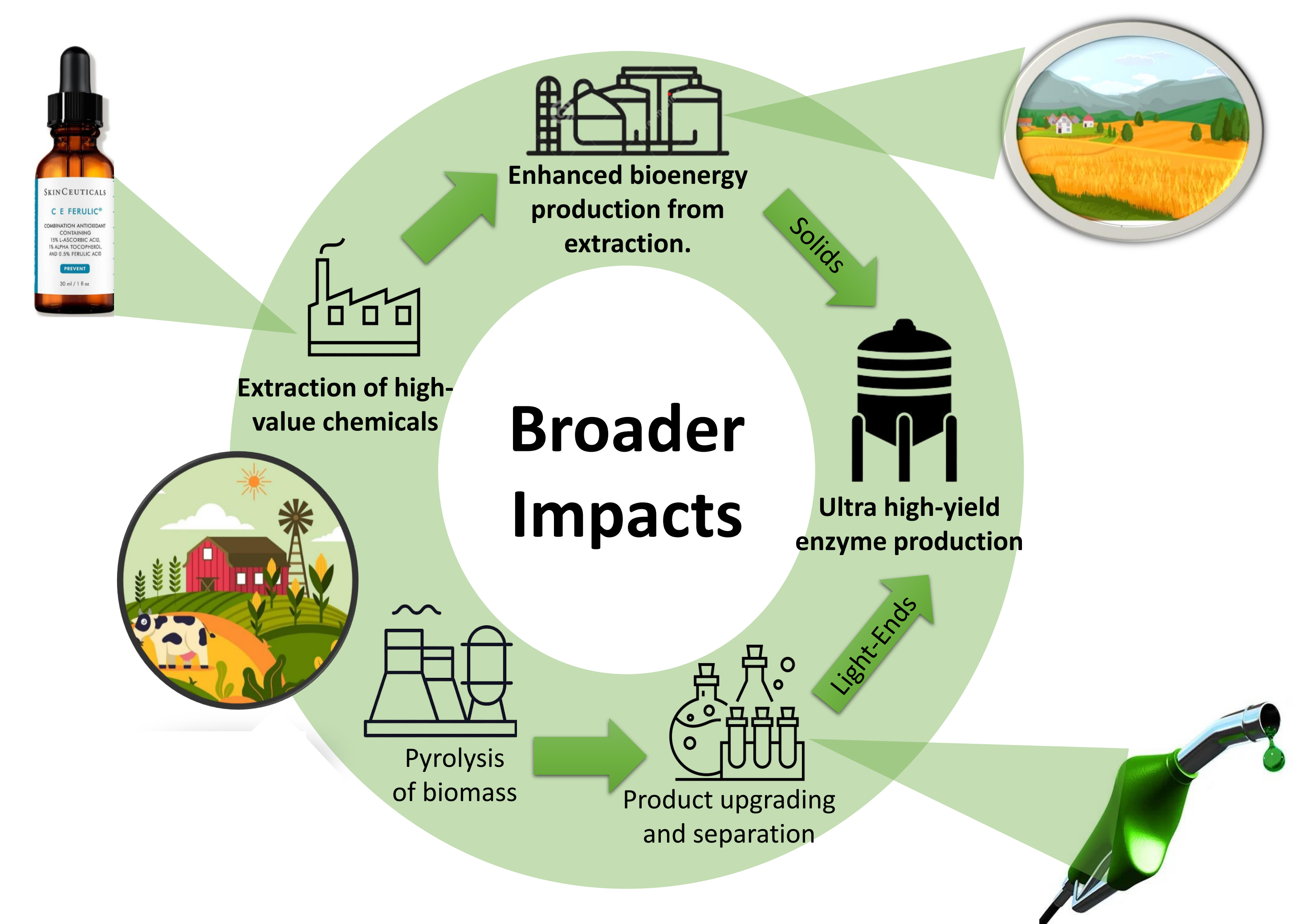
Laccase Pretreatment

- These laccases were evaluated as an enzymatic pretreatment for prairie grass.
- Temperature and enzyme loading were evaluated using statistical DOE.
- Optimized conditions resulted in 35% improvement in biomass digestibility.



Future Prospective

- Manuscript for this work is currently in writing.
- Techno-economic analysis of several scenarios planned to begin in early 2023.



Economic Impacts

- Cellulosic biofuel systems are rarely profitable without subsidies, due to their low-value products.
- Pretreatment is often necessary for bioprocessing, but overly expensive.
- HCA extraction may provide a pretreatment option that's effective and generates added revenue for the plant.

Environmental Impacts

- Cellulosic biorefineries can provide sustainable replacements for fossil fuels and petroleum-derived chemicals.
- Cellulosic feedstocks do not compete for land, thereby mitigating indirect land use change.
- Laccases are known to assist in the degradation of harmful pollutants, such as antibiotics, dyes, personal care products, and BPA.

Social Impacts

- Biorefineries offer jobs and economic opportunities, particularly in rural communities.
- Domestic fuel production reduces the dependency of fossil fuel imports and assists in fuel price stabilization.