BRC Science Highlight
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Variability in Structural Carbohydrates, Lipid Composition, and Cellulosic Sugar Production from Industrial Hemp Varieties

Background/objective

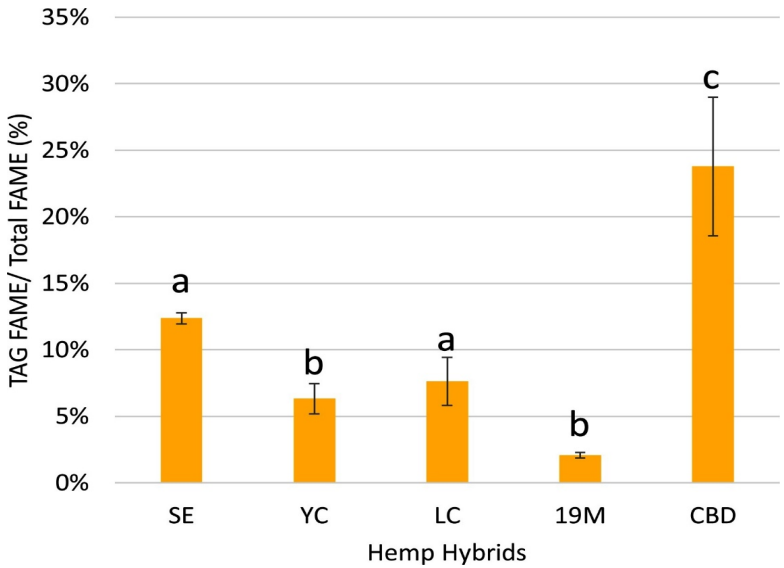
While industrial hemp (*Cannabis sativa*) is traditionally grown for its seeds and fiber, its high carbohydrate content makes it a potential candidate as a bioenergy crop. The objective of this study was to evaluate the variation in structural carbohydrate and lipid composition among five different industrial hemp varieties. This study also looked at cellulosic sugar yield using low severity liquid hot water (LHW) pretreatment followed by disk refining and subsequent enzymatic hydrolysis.

Approach

- Five hemp varieties selected for this study included: SC (Seward County), YC (York County), LC (Loup County), 19m (19m96136) and CBD (CBD Hemp)
- Composition of hemp varieties was determined using the National Renewable Energy Laboratory's analytical procedure, including water and ethanol extractives, carbohydrates, lignin, and ash
- Total lipids were extracted using hexane and developed on a thin layer liquid chromatography (TLC) plate to separate and analyze lipid content in hemp varieties
- Sugar yields were recovered from enzymatic hydrolysis of LHW pretreated, disk-milled biomass

Results

- Total carbohydrate content (Glucan and Xylan) of hemp varieties was similar to sugarcane bagasse and corn stover — but less than bioenergy sorghum
- Approximately 25% of total lipid in the CBD hemp variety was TAG (triacylglycerol) based on gas chromatographic (GC) analysis
- High sugar recovery was achieved in all hemp varieties due to low severity pretreatment coupled with disk refining



Relative amount of TAGs from total lipids was calculated from GC analysis. CBD hemp was the most TAG-rich hemp variety (~25% of total lipid), whereas TAG comprised only ~2% of the total lipid in 19 m hemp.

Significance

Our findings suggest that hemp is a promising energy crop with the possibility of producing both ethanol and biodiesel. By learning more about the structural carbohydrates, lipid composition, and sugar yield, we are laying the foundation for hemp as a bioenergy crop. Future work will include a detailed technoeconomic analysis to evaluate economic potential, and the sustainability of hemp biofuels will be investigated by comparing its economics with lipid-producing sugarcane-based biofuels.

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