

Nearly Quantitative Water Solubilization of DDGS and Other Lignocellulosic Materials with a Commercially Available Compound (CAC)

"Dr. Verkade! Some prankster keeps stealing my boiling stick!"
David Hendricker, Ph.D. student, 1964
"Dr. Verkade! You have got to see this! The stick is dissolving!"
David Hendricker, Ph.D. student, 1964

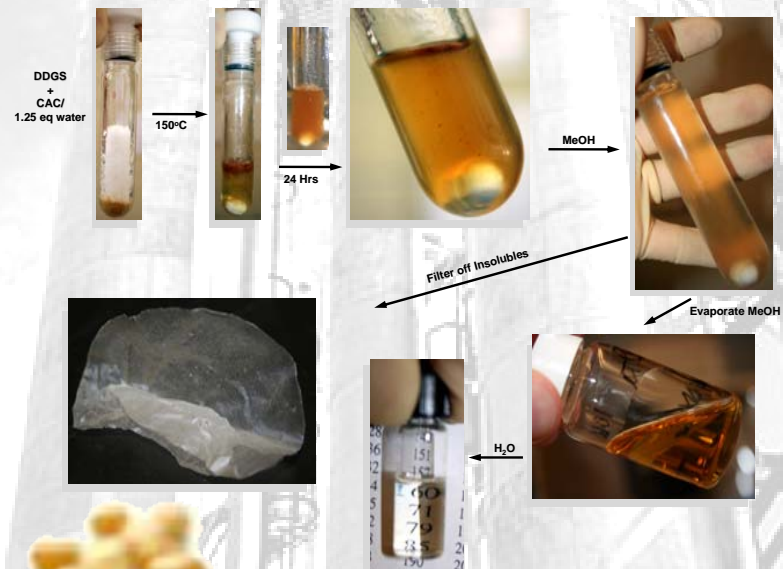
"Just add water!"
Reed E. Oshel, M.S. student, 2006

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Motivation

- Production of fermentable sugars from Distillers Dry Grains and Solubles (DDGS)
- Potential for production of fermentable sugars from other lignocellulosic materials
- Use relatively inexpensive, commercially available reagents

Treatment



Just Add Water^a

Water ^b	DDGS-CAC solution ^c	% Soluble ^d
0.00 eq	3.5% w/w	19%
1.25 eq	3.5% w/w	99%
1.25 eq	50% w/w	86%
0.10 eq	3.5% w/w	37%
10.0 eq ^e	27% w/w	89%
2.00 eq ^f	5.6% w/w	100%
1.25 eq MeOH	3.5% w/w	88%

^aAll treatments were performed with 250 mg Hot Water Treated (HWT) DDGS (i.e. Jight stillage heated to 160°C dried and ground to 0.5 mm) heated at 150°C for 48 Hrs. ^bBased on ratio of moles of water:moles of CAC. ^cWt of DDGS/wt of CAC. ^dDetermined from (weight of insoluble material after methanol treatment)/(initial weight of lignocellulosic material) x 100%. ^e1 mL water and 10 mol% CAC based on water, reaction mixture turned black. ^f1 mL water and 50 mol% CAC based on water.

Significant Results

- Protocol applicable to variety of lignocellulosic materials
- Glycosidic bonds are broken
- 48% DDGS solutions are achievable
- Protocol solubilizes lignin

Acknowledgements

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Lignocellulosics^a

Lignocellulosic	% Soluble ^b
Boiling Stick ^c	87%
Corn Stalk ^{d, e}	54% ^k
Poplar ^d	98%
Pine ^d	99%
DG ^{d, f}	78% ^k
Cotton	94%
Cellulose ^g	99%
Cellobiose ^h	100%
Me-Cellobiose ^{h, i}	100% ^k
Pine Lignin ^j	99% ^k

^aAll treatments were performed with 3.5% lignocellulosic in CAC by weight at 150°C for 48 Hrs in a sealed pressure tube with constant stirring. ^bDetermined from (weight of insoluble material after methanol treatment)/(initial weight of lignocellulosic) x 100%. ^cBonded balsa wood. ^dDried and ground to 0.5 mm. ^eEntire corn stalk including pith. ^fObtained from Big River Resources LLC. ^gChromatography grade from Aldrich. ^hD-(+)-cellobiose from Aldrich. ⁱPermethylated according to Mendonca and Laine. ^jCarbohydr. Res. 2005, 2055-59. ^kIndulin AT kraft pine lignin from Westvaco. ^l100°C

Further Investigations

- Optimize CAC and water amounts
- Solubility determination of other lignocellulosic materials (corn stover, switchgrass, kenaf, etc.)
- Separation and identification of solubilized species
- Maximize lignocellulosic concentrations in water (We are at 43 or 48% wt %?)
- Aqueous solution utility determination downstream
- Determine CAC recovery