

Verification of the NCERC Starch and Cellulose Methods for Testing Corn Matrix Samples Using Flask Fermentation

**National Corn to Ethanol Research Center
Southern Illinois University Edwardsville**

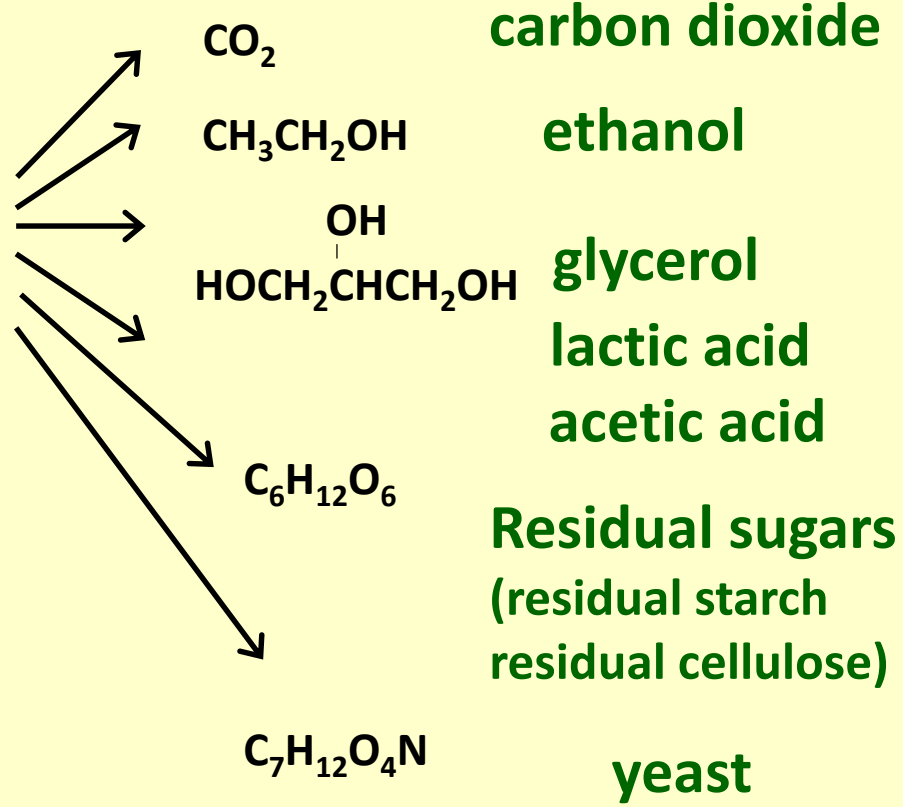
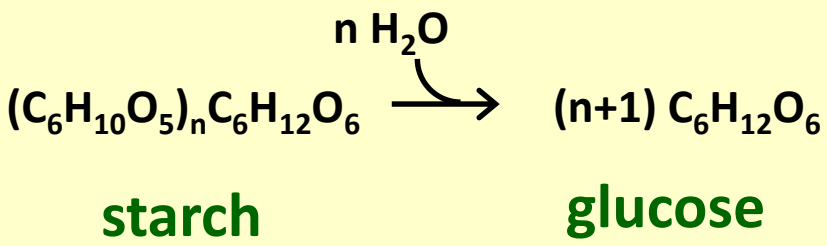


Advancing Biofuels Research
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Carbon Balance on Ethanol Fermentation

Hydrolysis

Fermentation



Flask Fermentation as Evaluation Criteria (calculate carbon balance)

Before Conversion (**BC**)

Starch and cellulose method on corn slurry samples

After Conversion (**AC**)

Carbon Dioxide (**CO₂**)- weight loss method

Ethanol (**EtOH**) - NCERC method

By products (**BY**) - HPLC method

Residual sugars (**RS**) - starch method

Residual cellulose (**RC**) - cellulose method

Yeast (**Yeast**) – yeast counting + literature

Carbon Balance on Ethanol Fermentation (1 G)

No. of Flasks (C g/flask)	BC	CO ₂	EtOH	BY	RS	Yeast	Total AC	Percent Recovery (%)
6	15.1	4.2	8.0	0.6	0.6	0.9	14.2	94
(±)	0.0	0.1	0.1	0.0	0.1	0.1	0.3	2
3	14.4	4.0	7.6	0.6	1.0	0.8	14.0	98
(±)	0.0	0.1	0.1	0.0	0.0	0.2	0.1	1
4	14.1	4.0	8.1	0.6	0.9	1.2	14.8	105
(±)	0.0	0.0	0.0	0.0	0.1	0.2	0.3	2

Carbon Balance on Ethanol Fermentation (pure cellulose)

Flask # (C g/flask)	BC	CO ₂	EtOH	BY	RC	Yeast	Total AC	Percent Recovery (%)
4	2.2	0.2	0.3	0.0	1.8	0.1	2.4	106
5	2.2	0.2	0.3	0.0	1.8	0.1	2.4	107

Carbon Balance on Ethanol Fermentation (1.5G)

Flask # (C g/flask)	BC (RS)	BC (RC)	CO ₂	EtOH	BY	RS	RC	Yeast	Total AC	Percent Recovery (%)
7	0.6	0.9	0.2	0.4	N.A.*	0.5	0.1	N.A.	1.2	82
10	0.6	0.9	0.2	0.4	N.A.	0.2	0.4	N.A.	1.2	83
12	0.6	0.9	0.2	0.4	N.A.	0.5	0.3	N.A.	1.4	94

*N.A., not available for now

Summary on Mass Balance for Corn to Ethanol Fermentation

- **Provided an independent criteria to evaluate the accuracy of testing starch and cellulose in the before and after conversion samples**
- **Provide scientifically sound ethanol production data for the industry**
- **Provide in-depth analysis of fermentation processing, especially for trouble shooting**

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Using lab scale *in situ* fermentation:

1. Existing data support increase of ethanol and CO₂ production after just dosing cellulase
2. Both hemicellulose and cellulose data of AC samples suggested cellulosic conversion, but with batch-to-batch variation
3. Explore the possibility of mild condition pretreatment to increase the cellulosic conversion

Acknowledgement

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