The cellulosic biorefinery: co–products extraction from biomass

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Overview

- The opportunity
- Constraints
- Examples
The opportunity

- Energy Independence and Security Act of 2007 Section 202: 36 billion gallon/yr of advanced biofuels by 2022
- Corn to ethanol contribution capped at 15 billion gallon/yr
- Advanced biofuels production: 21 billion gallon/yr of advanced biofuels
- 21 billion gallon/yr: 250 million dry ton of biomass
When biorefineries are deployed
Of the 250 million dry tons of biomass
Certain co-products could be extracted
Prior or post conversion
Similar to the existing corn to ethanol biorefinery
Too early to bring specifics
Figure 2. Biorefinery with co-products extraction.
Constraints

- Extraction step needs to be harmonized with bio refinery bioprocessing
- Extraction needs to be in pressurized hot water below 140°C
- Extraction could be in dilute acid
- Examples with pressurized hot water:
  - Carvone *Mentha piperita*
  - Linalool *Satureja hortensis*
  - Paclitaxel *Taxus cuspidate*
Constraints

- 50 million gallon per year
- 80 gallons per dry ton
- 2000 dry tons per day
- Co-products need to be extractable with pressurized
- Co-products need to be of sufficient value to warrant added step in biorefinery
- Market needs to be capable of absorbing production
Examples

- Black locust (*Robinia pseudoacacia* L)

Flavonoid acacetin showed activity in cancer cell lines. Lectin robin inhibits protein synthesis.
Examples

- Eucalyptus

Flavonoids showed activity as antioxidant
Monoterpenes ingredient in Listerine® activity
Staphylococcus aureus
Examples

- Sorghum

Policosanols inhibit oxidation of LDL key element in inflammatory diseases
Examples

- Sweetgum (*Liquidambar styraciflua* L.)

  Essential oils composition is similar to that of Australian tea tree oil, antimicrobial and anti-fungal activity.
Examples

- Switchgrass, *Panicum virgatum* L.

  - **Policosanols**
    - Inhibits oxidation of LDL
  - **Flavonoids**
    - rutin and quercitrin
  - **Antioxidants**
    - Vitamin E
Feasible?

1. High value
2. Not flood chemical market
3. Does not interfere with biorefinery operation
4. Extraction can be conducted at holding site, at harvest site or at the biorefinery
5. Extraction infrastructure integrated
Conclusions

- The opportunity selected phytochemicals
- **Constraints** can be extracted with water or dilute acid
- **Examples** possible with specific biomass
Thank you
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