Comparison of the NRC 2001 Model and DVE/OEB (Dutch) System in the prediction of protein supply to dairy cows from new co-products of bio-ethanol production

$\text{AMCPDVE} = 0.85 \times 0.75 \times \text{MCPFOM}$

$\text{AMCPNRC} = 0.80 \times 0.80 \times \text{MCPNRC}$

$\text{MP} = \text{ARUP}^{\text{NRC}} + \text{AMCP}^{\text{NRC}} + \text{AECP}$

$\text{RUP}^{\text{DEV}} = 1.1 \times \text{CP} \times \%\text{RUP}$

$\text{AMCP}^{\text{NRC}} = 0.80 \times \text{CP}$

$\text{RUP}^{\text{NRC}} = \text{CP} \times \%\text{RUP}$

$\text{DVE} = \text{ARUP}^{\text{DVE}} + \text{AMCP}^{\text{FOM}} - \text{ENDP}$

$0.75 \times \text{MCP}^{\text{FOM}}$

Waldo Nuez Ortin

EAAP 2009
Research Justification

- Increased ethanol production capacity in western Canada

- 1.4 million mt of feedstock
- 512 million liters of ethanol
- 460,000 mt of DDGS
  - 38% wheat
  - 62% wheat/corn

www.ddgs.usask.ca
Research Justification

- **Europe** (2.8 billion liters of ethanol in 2008)

DDGS production by country in 2010

- Hungary
- France
- Germany
- Spain
- Belg-Lux
- Bulgaria
- Austria
- Sweden
- Lithuania
- Netherlands
- Poland
- Finland

![Graph showing DDGS production by country in 2010](http://www.allaboutfeed.net)

---

EAAP 2009
Dietary protein evaluation of DDGS for ruminants

- Chemical profile, CNCPS *(Nuez Ortin and Yu, 2009)*
  - CP (%DM): 14% (wheat) vs. 39% (wheat DDGS) vs. 32% (corn DDGS)
  - PB2 (%CP): 62% vs. 28% vs. 54%
  - PB3 (%CP): 15% vs. 51% vs. 28%

- In situ rumen procedure *(Batajo and Shaver 1998, Grings et al. 1992)*
  - RUP (%CP): 46% (corn) vs. 60% (corn DDGS)

- Intestinal digestibility of RUP *(NRC 2001)*
  - dRUP: 90% (corn) vs. 75% (corn DDGS)
Research Justification

- Modern protein evaluation models
  - Chemical profile
  - In situ rumen degradation characteristics
  - Intestinal digestibility of CP

- DVE/OEB (Dutch) System \((Tamminga \textit{et al.} 1994)\)
- NRC 2001 Model \((NRC 2001)\)

- Ruminal and postruminal availability of protein

DDGS

EAAP 2009
Objective

Prediction of protein supply of DDGS to dairy cows using NRC 2001 and DVE/OEB System

1) Magnitude of difference
   - feedstock vs. wheat DDGS vs. corn DDGS vs. blend DDGS

2) DVE/OEB System vs. NRC 2001 Model
Methodology

■ Samples
  ▪ Wheat (3)
  ▪ Corn (3)
  ▪ Wheat DDGS (5)
  ▪ Blend DDGS (70% wheat:30% corn) (3)
  ▪ Corn DDGS (3)

■ Animals
  ▪ 3 rumen fistulated Holstein cows (dry)
Methodology

Rumen incubation at 0, 2, 4, 8, 12, 24, 48 and 120h (2 runs)

Original sample: DM, Ash, CP, NDF, Starch, EE
Residue: DM, Ash, CP, NDF, Starch

S, D, U, T0, F0, Kd (CP and starch)

Intestinal dRUP
TDN value
Fermented OM

Orskov and McDonald, 1979
Calsamiglia and Stern, 1995
Weiss et al. 1992
Tamminga et al. 1994

DVE/OEB System
Non TDN Model
NRC 2001 Model
TDN Model
## Methodology

### Availability of protein in SI

<table>
<thead>
<tr>
<th>DVE/OEB System</th>
<th>NRC 2001 Model</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>True absorbable protein in SI (DVE)</strong></td>
<td><strong>Metabolizable protein (MP)</strong></td>
</tr>
<tr>
<td>Absorbable RUP</td>
<td>Absorbable RUP</td>
</tr>
<tr>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Absorbable microbial protein synthesized in rumen</td>
<td>Absorbable microbial protein synthesized in rumen</td>
</tr>
<tr>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>Endogenous CP losses</td>
<td>Absorbable endogenous CP</td>
</tr>
</tbody>
</table>
Methodology

- Degraded protein balance

DVE/OEB System
(Non-TDN Model)

Degraded protein balance (OEB)

Microbial protein synthesis\(_{\text{RDP}}\)

- Microbial protein synthesis\(_{\text{FOM}}\)

NRC 2001 Model
(TDN Model)

Degraded protein balance (DPB)

Microbial protein synthesis\(_{\text{RDP}}\)

- \(1.18 \times \) Microbial protein synthesis\(_{\text{TDN}}\)
Methodology

- Statistical analysis
  -_DDGS type effect on protein availability (Objective 1)
    - CRD
      - Batches and runs as replicates
      - SAS Mixed procedure
      - Means separation using Fisher Protected LSD method (P<0.05)
  - DVE/OEB System vs. NRC 2001 Model (Objective 2)
    - Paired t test
    - Correlation
Results (Objective 1)

DVE/OEB System

<table>
<thead>
<tr>
<th>g/kg DM</th>
<th>WHEAT</th>
<th>CORN</th>
<th>WHEAT DDGS</th>
<th>CORN DDGS</th>
<th>BLEND DDGS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- CP
- Microbial CP
- Endogenous CP
- RUP
- Absorbable microbial CP
- Absorbable RUP

Means with same letter in the same block are not significantly different (P>0.05) LSD method
Results (Objective 1)

DVE/OEB System

-50 0 50 100 150 200 250 300 350 400

WHEAT CORN WHEAT DDGS CORN DDGS BLEND DDGS

CP
True absorbable protein in SI (DVE)
Degraded protein balance (OEB)

a, b, c, d Means with same letter in the same block are not significantly different (P>0.05) LSD method
Results (Objective 1)

NRC 2001 Model

Means with same letter in the same block are not significantly different (P>0.05) LSD method
Results (Objective 1)

NRC 2001 Model

- CP
- Metabolizable CP (MP)
- Degraded protein balance (DPB)

a, b, c, d Means with same letter in the same block are not significantly different (P>0.05) LSD method
## Results (Objective 2)

### DVE/OEB System vs. NRC 2001 Model

<table>
<thead>
<tr>
<th>Items</th>
<th>Mean DVE/OEB</th>
<th>Mean NRC 2001</th>
<th>Difference</th>
<th>SED</th>
<th>P value</th>
<th>R</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absorbable microbial CP</td>
<td>53.98</td>
<td>60.10</td>
<td>-6.11</td>
<td>1.267</td>
<td>&lt;0.0001</td>
<td>-0.44</td>
<td>0.0405</td>
</tr>
<tr>
<td>Absorbable endogenous CP</td>
<td>6.32</td>
<td>4.39</td>
<td>1.92</td>
<td>0.394</td>
<td>&lt;0.0001</td>
<td>0.45</td>
<td>0.0371</td>
</tr>
<tr>
<td>Absorbable RUP</td>
<td>210.35</td>
<td>189.50</td>
<td>20.85</td>
<td>0.664</td>
<td>&lt;0.0001</td>
<td>1.00</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Metabolizable CP/DVE</td>
<td>258.01</td>
<td>253.99</td>
<td>4.01</td>
<td>0.793</td>
<td>&lt;0.0001</td>
<td>0.99</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Degraded protein balance</td>
<td>50.70</td>
<td>45.94</td>
<td>4.76</td>
<td>2.728</td>
<td>0.0957</td>
<td>0.97</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Paired t test. Pearson correlation.
Conclusion

DVE/OEB System vs. NRC 2001 Model for DDGS evaluation:

- True absorbable protein in SI (DVE/MP):
  - DDGS > feedstock grain
  - Blend DDGS (70:30) > wheat DDGS = corn DDGS

- Balance between microbial protein synthesis from available RDP and available energy (DPB):
  - Corn DDGS showed the closest to zero value

- Absorbable RUP
  - MP/DVE was higher for the DVE/OEB System
Thank you!!

Advisor:
Dr. Peiqiang Yu

Advice Committee Members:
Dr. Dave Christensen
Dr. John McKinnon
Dr. Bernard Laarveld