Soybean, Canola and Cottonseed Meal
In- Sacco technique for estimation of ruminal degradability of soybean, canola, and cottonseed meal

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PROTEIN DIGESTION IN RUMINANTS

- Rumen

  - True protein
  - NPN

  Recycled via saliva
  
  (20% of dietary N)

  Undegraded

  Degraded

  NH₃ → Microbial protein

  NH₃ → Liver

  Urea

  Small intestine
  
  Metabolizable protein

  Excreted
• **Ruminal degradation of true protein**
  
  – Two steps
    * Proteolysis-slow
    * Deamination-rapid
  
  – By ruminal bacteria and protozoa
    * All proteases are cell-bound
      - Bacterial proteases are extracellular; require attachment
      - Protozoal proteases are intracellular; engulf feed and bacterial proteins
  
  – Endproducts
    * C-chains
      - Volatile fatty acids
        » Straight chain (Acetic acid)
        » Branched chain (Isovaleric, Isobutyric, 2-methyl butyric acids)
      - Ketones
    * Ammonia
    * CO₂
Protein Pathways in the Ruminant

FIGURE 16.9 Protein pathways in the ruminant. Courtesy of J. Bryant and B. R. Moss, Montana State University.
General Information

• No proteases in saliva
• No rumen secretions
• Microorganisms responsible for protein digestion in rumen (and reticulum)
  – Bacteria
  – Protozoa
Sources of Rumen Nitrogen

• Feed
  – Protein nitrogen
    • Protein supplements (SBM, CSM, grains, forages, silages...)
  – Nonprotein nitrogen (NPN)
    • Usually means urea
    • However, from 5% of N in grains to 50% of N in silage and immature forages can be NPN

• Endogenous (recycled) N
  – Saliva
  – Rumen wall
NPN Utilization

• Urea (and most sources of NPN) rapidly degraded to $\text{NH}_3$
• MO’s don’t care where $\text{NH}_3$ comes from
Limitations of Microbial Protein Synthesis

- Two most likely limitations
  - Energy available
  - \( \text{NH}_3 \) available
  - These need to be synchronized

- For diets containing urea, may also need
  - Sulfur (for S-containing AA)
  - Branched-chain C-skeletons
    - MO cannot make branched-chain C-chains
  - These normally not a problem
Overflow Ammonia

- Shortage of energy relative to available NH$_3$
- Liver: NH$_3$ $\rightarrow$ Urea
- Urea recycled or excreted, depending on animal needs
  - Saliva
  - Rumen wall
Protein Leaving Rumen

- Microbial protein
- Escape protein (also called “bypass” protein)

- Enter abomasum & small intestine
  - Digested by proteolytic enzymes similar to nonruminants

- Escape vs Bypass protein
  - Technically not “bypass”
  - Reticular groove
CONSIDERATIONS TO LIMIT N EXCRETION BY RUMINANTS

• Supply adequate degradable N to meet ammonia needs of rumen microbes
• Supply adequate metabolizable protein to meet the amino acid needs of the animal for maintenance and production

PROTEIN DIGESTION IN RUMINANTS

• Rumen

Total protein NPN

Recycled via saliva (20% of dietary N)

Undegraded

Degraded

NH₃ ➔ Microbial protein

NH₃ ➔ Liver

Urea ➔ Kidney ➔ Excreted

Small intestine Metabolizable protein
In-Sacco technique for estimation of ruminal degradability of soybean, canola, and cottonseed meal
In-Sacco (The nylon bag technique)

The nylon bag technique described by Ørskov et al (1980) for the determination of the degradation of feedstuffs in the rumen at various incubation periods can be used to screen feeds at the initial stages of assessing their nutritive values.

Awareness of soybean, canola, and cottonseed meal ruminal degradability can plays a very important role in our understanding of relation between meal and animal nutrition,
Using in-sacco technique in three castrated male Zel sheep
This research was conducted in order to investigate rumen degradability of some factors includes;

Dray matter (DM)
Organic matter (OM)
Crude protein (CP)
Acid detergent fiber (ADF)

In three different plant protein supplements includes;
    soybean, canola, and cottonseed meal
Researchers determined the level of effective degradability (ED) with three different sources in fistulated sheep.
Results
Table 1. Degradation Parameters and Effective Degradability of Soybean Meal Produced in Mazandaran Province, Iran, Behpak Oil Plant

<table>
<thead>
<tr>
<th>Oilseed Meal</th>
<th>Degradation Parameters (%)</th>
<th>C (%/hr)</th>
<th>Effective Degradation (0.05/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean Meal</td>
<td>a</td>
<td>b</td>
<td>a±b</td>
</tr>
<tr>
<td>Dry Matter (%)</td>
<td>29.3</td>
<td>69.1</td>
<td>98.4</td>
</tr>
<tr>
<td>Organic Matter (%)</td>
<td>28.8</td>
<td>71.2</td>
<td>100</td>
</tr>
<tr>
<td>ADF (%)</td>
<td>28.7</td>
<td>59.8</td>
<td>88.5</td>
</tr>
<tr>
<td>Crude Protein (%)</td>
<td>29.3</td>
<td>69.2</td>
<td>98.5</td>
</tr>
</tbody>
</table>
Table 2: Degradation Parameters and Effective Degradability of Canola Meal Produced in Mazandaran Province, Iran. Behpak Oil Plant

<table>
<thead>
<tr>
<th>Oilseed Meal</th>
<th>Degradation Parameters (%)</th>
<th>C (%/hr)</th>
<th>Effective Degradation (0.05/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canola Meal</td>
<td>a</td>
<td>b</td>
<td>a±b</td>
</tr>
<tr>
<td>Dry Matter (%)</td>
<td>24.9</td>
<td>58.1</td>
<td>83.0</td>
</tr>
<tr>
<td>Organic Matter (%)</td>
<td>29.8</td>
<td>57.3</td>
<td>87.1</td>
</tr>
<tr>
<td>ADF (%)</td>
<td>30.8</td>
<td>49.2</td>
<td>80.0</td>
</tr>
<tr>
<td>Crude Protein (%)</td>
<td>32.7</td>
<td>66.0</td>
<td>98.7</td>
</tr>
</tbody>
</table>
Table 3. Degradation Parameters and Effective Degradability of Cottonseed Meal Produced in Mazandaran Province, Iran., Behpak Oil Plant

<table>
<thead>
<tr>
<th>Oilseed Meal</th>
<th>Degradation Parameters (%)</th>
<th>C (%/hr)</th>
<th>Effective Degradation (0.05/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cottonseed Meal</td>
<td>a</td>
<td>b</td>
<td>a±b</td>
</tr>
<tr>
<td>Dry Matter (%)</td>
<td>35.6</td>
<td>18.6</td>
<td>54.2</td>
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<tr>
<td>Organic Matter (%)</td>
<td>36.5</td>
<td>21.3</td>
<td>57.8</td>
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<tr>
<td>ADF (%)</td>
<td>18.9</td>
<td>34.6</td>
<td>53.5</td>
</tr>
<tr>
<td>Crude Protein (%)</td>
<td>34.8</td>
<td>22.0</td>
<td>56.8</td>
</tr>
</tbody>
</table>
Table 4. Degradation Parameters and Effective Degradability of Soybean Meal Produced in Mazandaran Province, Iran., Culture and Industry Oil Plant

<table>
<thead>
<tr>
<th>Oilseed Meal</th>
<th>Degradation Parameters (%)</th>
<th>C (%/hr)</th>
<th>Effective Degradation (0.05/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean Meal</td>
<td>a</td>
<td>b</td>
<td>a±b</td>
</tr>
<tr>
<td>Dry Matter (%)</td>
<td>26.8</td>
<td>56.7</td>
<td>83.5</td>
</tr>
<tr>
<td>Organic Matter (%)</td>
<td>27.5</td>
<td>56.0</td>
<td>83.5</td>
</tr>
<tr>
<td>ADF (%)</td>
<td>29.9</td>
<td>46.4</td>
<td>76.3</td>
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<tr>
<td>Crude Protein (%)</td>
<td>26.8</td>
<td>54.9</td>
<td>81.7</td>
</tr>
</tbody>
</table>
Table 5. Degradation Parameters and Effective Degradability of Canola Meal Produced in Mazandaran Province, Iran. Culture and Industry Oil Plant

<table>
<thead>
<tr>
<th>Oilseed Meal</th>
<th>Degradation Parameters (%)</th>
<th>C (%/hr)</th>
<th>Effective Degradation (0.05/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canola Meal</td>
<td>a b a±b 0.05</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dry Matter (%)</td>
<td>29.2 51.6 80.8 0.051</td>
<td></td>
<td>55.2</td>
</tr>
<tr>
<td>Organic Matter (%)</td>
<td>30.3 53.0 83.0 0.045</td>
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<td>55.1</td>
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<tr>
<td>ADF (%)</td>
<td>26.6 46.4 73.0 0.077</td>
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<td>55.1</td>
</tr>
<tr>
<td>Crude Protein (%)</td>
<td>33.8 56.3 90.1 0.040</td>
<td></td>
<td>58.7</td>
</tr>
</tbody>
</table>
Table 6. Degradation Parameters and Effective Degradability of Sunflower Meal Produced in Mazandaran Province, Iran., Culture and Industry Oil Plant

<table>
<thead>
<tr>
<th>Oilseed Meal</th>
<th>Degradation Parameters (%)</th>
<th>C (%/hr)</th>
<th>Effective Degradation (0.05/hr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunflower Meal</td>
<td>a</td>
<td>b</td>
<td>a±b</td>
</tr>
<tr>
<td>Dry Matter (%)</td>
<td>16.0</td>
<td>66.1</td>
<td>82.1</td>
</tr>
<tr>
<td>Organic Matter (%)</td>
<td>17.9</td>
<td>63.0</td>
<td>80.9</td>
</tr>
<tr>
<td>ADF (%)</td>
<td>23.3</td>
<td>53.6</td>
<td>76.9</td>
</tr>
<tr>
<td>Crude Protein (%)</td>
<td>6.6</td>
<td>83.9</td>
<td>90.5</td>
</tr>
</tbody>
</table>
Conclusion:

• CP were 55.8, 62, and 48.3 percentage
• ADF were 55, 56.4, and 37.6 percentage
• OM were 55.7, 56.4, and 47.4 percentage
• DM were 55.8, 73.8, and 48.5 percentage
The results reveal that In-sacco technique can be as a novel strategy for the determination of ruminal degradability of soybean, canola, and cottonseed meal through the use of fistulated sheep.
Thank you for your attention