### Efficiency of nitrogen utilization for livestock production

<table>
<thead>
<tr>
<th></th>
<th>Product Meat or Milk</th>
<th>Manure Feces and Urine</th>
<th>Volatilized</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>N-use efficiency, % of N intake</strong></td>
<td></td>
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<td></td>
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<tr>
<td><strong>Beef</strong></td>
<td></td>
<td></td>
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<tr>
<td>Feedlot</td>
<td>10 to 20</td>
<td>80 to 90</td>
<td>50 to 85</td>
</tr>
<tr>
<td>Pasture</td>
<td>&lt; 10</td>
<td>&gt; 90</td>
<td></td>
</tr>
<tr>
<td><strong>Dairy</strong></td>
<td>20 to 35</td>
<td>65 to 80</td>
<td>30 to 75</td>
</tr>
<tr>
<td><strong>Swine and Poultry</strong></td>
<td>30 to 40</td>
<td>60 to 70</td>
<td>35 to 70</td>
</tr>
</tbody>
</table>
Dynamics of protein metabolism in the ruminant

Feed protein

Rumen

Rumen Microbiome

Undegradable protein

Degradable protein

Peptides + amino acids

NH₃

Microbial protein

CH₂O

Endogenous protein

Small intestine

Digestible protein

Peptides + amino acids

Indigestible protein

Large intestine

NH₃

CH₂O

Microbial protein

Tissues

Maintenance

Growth

Conceptus

Lactation

Meat

Milk

Urine (Urea)

Feces

Plasma urea

AA
Feed Protein

- Amount Fed
- Form Fed – Degradable vs Undegradable
- Amino acid profile

BALANCED AND PRECISION FEEDING
N utilization in lower tract

Absorption

Rumen
- Undegradable protein
- Degradable protein
- Peptides + amino acids
- Microbial protein
- NH₃

Small intestine
- Digestible protein
- Peptides + amino acids
- Indigestible protein

Large intestine
- Microbial protein
- CH₂O

Tissues
- Maintenance
- Growth
- Conceptus
- Lactation

Plasma urea

Meat
- Milk

Urine (Urea)

Feces

Endogenous protein

AA

NH₃
Absorption
Intestinal microbiome
Host Transcriptomics
Host Proteomics

Small intestine

Di-, Tripeptides Na^+
Amino acids Na^+
Amino acids

Peptides
Amino acids

Blood

ATPase Na^+
K^+

Amino acids
Amino acids
Impacts of Productive state of the animal

Rumen

Undegradable protein

Degradable protein

Peptides + amino acids

Microbial protein

NH₃

Endogenous protein

Digestible protein

Peptides + amino acids

Indigestible protein

Small intestine

Large intestine

Plasma

urea

NH₃

CH₂O

AA

Tissues

Animal

Maintenance

Growth

Conceptus

Lactation

Meat

Milk

Urine

Microbial protein

Feces

(Urea)
Manure Handling Systems
Thank you
Questions?
Tannins

- Occur naturally in many plant species (forages, shrubs, legumes)
- Harmful and beneficial effects depending on structure and concentration
- Bind proteins and to a lesser extent carbohydrates and minerals

Condensed tannin (CT)
polymeric flavonoids

Hydrolysable tannin (HT)
carbohydrate esterified with phenolic acid
Plant tannins as feed additives for high protein diets containing distillers grains to shift the route of N excretion from urine to feces and reduce ammonia emissions from beef feedlot cattle

- **Plant extracts**: *Acacia mearnsii*, Quebracho, Chestnut, Tannic acid, Gallic acid
  - Beef cattle metabolism studies - N digestion and route of excretion
  - Growth performance of feedlot cattle
  - NH3 emissions - Isolation pens
Cumulative ammonia emissions from manure of beef cattle fed condensed and hydrolysable tannins.
Dynamics of protein metabolism in the ruminant

Absorption

- Undegradable protein
- Degradable protein
- Peptides + amino acids
- NH₃
- Microbial protein
- Plasma urea
- NH₃
- CH₂O
- Microbial protein
- Urea (Meat, Milk)
- Feces
- Urine

Rumen
- Indigestible protein
- Digestible protein
- Peptides + amino acids
- Endogenous protein
- Small intestine
- Large intestine

Tissues
- Maintenance
- Growth
- Conceptus
- Lactation

Conceptus
- Lactation

Maintenance
- Growth

Meat
- Milk

Small intestine
- Large intestine