Optimizing productivity from pasture-based systems – a case study for high forage feeding levels
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Introduction
• Role of milk in an uncertain future
• High forage and byproduct inclusion
• Overview pasture based systems
• Nutritional considerations

Food security and future demand
• Sufficient global aggregate food for everyone to be well fed
• Range (available kcal/person/day)
  • 1.9 bn > 3000
  • 2.3 bn. people < 2,500
• 1 in every 9 undernourished
• Dairy (excl. butter) kg/person/year:
  – Developed 202 → 222
  – Developing 52 → 76
  – World 83 → 99
• Future milk production requirement to increase from 844 m tonnes to 1,077 m tonnes (67% rise)

Constraints
• Growing competition feed versus food
  – 2.5 billion ha used for livestock feeds
  • Half of global agricultural area
  • 34% could be converted to cropland
  • 50% rise in global arable land
• Consumer concerns
  – Inefficiency of livestock production
  – GMO/recombinant technologies
• Global warming
  – 14.5% of global greenhouse gas emissions
  – Weather events/patterns
• Nutrients supplied by livestock products:
  – 17% global kcals
  – 33% global protein

Food security and future demand

Constraints

Food security and future demand

Constraints
Why dairy products?

- Plant only production in U.S. = 23% increase in food calories available (White and Hall, 2017)
  - Increased nutrient deficiencies
  - Higher food solid intake required
  - Greater excess of energy

- Why not complement/balance plant diets with dairy:
  - Nutrient dense
  - High quality protein - digestible amino acids
  - Healthy fatty acids
  - Vitamin A, Vitamin B-12, riboflavin, calcium, iron and zinc
  - Can help meet many nutrition specific intervention strategies

Pasture based system – case study

- High forage diets – 90-100% inclusion levels
- High fiber (30-40% DM) - low starch
- Achieve large DMI
  - 3.5% BW
- Produce BW in milk solids
  - 510 kg MS; fat and protein
- Strong reproductive performance
  - 90% calving in 6 weeks

Fig. 1. Relationship between total cost of production and proportion of grazed grass in the dairy cow’s diet, ranging from total confinement feeding to grass-based feed systems. Source Dillon et al. (2005).
**Pre grazing yield determination**

- Cut and weight technique
- **Quadrat** = 0.5 m * 0.5 m
- **DM/ha** = X kg * DM% * 40,000
- .100 * .18 * 40,000 = 720 kg DM/ha
- .200 * .18 * 40,000 = 1440 kg DM/ha
- .250 * .18 * 40,000 = 1800 kg DM/ha
- .300 * .18 * 40,000 = 2160 kg DM/ha
Pasture inventory

- Understand feed supply
- Forward predict surplus or deficit and make proactive decisions
- Maintain pasture quality
Pre-grazing yield and digestibility
<table>
<thead>
<tr>
<th></th>
<th>Rate (%/h)</th>
<th>Passage (%/h)</th>
<th>Amount ruminally degraded</th>
<th>Pool size (%)</th>
<th>aNDFom ruminally degraded</th>
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</thead>
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<tr>
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<td>24</td>
<td>1.7</td>
<td>93</td>
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<tr>
<td>Slow Pool</td>
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<td>61</td>
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<td>1.7</td>
<td>0</td>
<td>9.4</td>
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<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
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<td>77</td>
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</tbody>
</table>

\[ \frac{kd}{kd+k_p} \]

\[ \text{pool size} \]
Cornell University

Irish Pasture Grass aNDFom Digestion behavior

Composition and Fiber Degradation characteristics

- Grasses are more filamentous and that lends to their digestion characteristics – more digestible, but more lignin and longer retention time in most cases.
  - Lignin in the leaves and stems which changes structural integrity – which means it is retained longer and has more digestible pools that influence retention – however low crosslinking and immaturity will offset this
Conclusion

- Future global net food production may encourage high fiber diets
- Controlling plant maturity of vital performance
- Characterization of NDF digestibility
- Diet formulation and management considerations
Animal agriculture can:

- Provide energy dense, highly nutritious products
- Increase net food production
- Further incorporate human food chain waste products
- Sequester carbon in highly productive grasslands

➢ Bright sustainable future for animal agriculture

Part of the solution

- High forage diets utilizing human food chain byproducts
- Which can result in:
  - Same if not greater production capability
  - Higher heFCR/net food production
  - Higher butterfat % and favorable profiles
  - Lower cost of production
  - Less dependence on off farm feed sources/food competition
Studies that have achieved this

| Table 5. Effect of treatments on the efficiency parameters feed conversion efficiency, rumen digestibility efficiency, and net feed production (mean ± SD, n = 3) and P value |
|---|---|---|---|---|---|---|
| Item | CC-RSM (control) | SIP-RSM | SIP-RSM | SIP-HSM | SEM | Treatment |
| Feed conversion efficiency, | 1.46 | 1.47 | 1.51 | 1.44 | 0.46 | 0.019 |
| kg of ECM/kg of DM | Diet¹ |
| Net energy | 0.53² | 0.56² | 0.57² | 0.57² | 0.01 | <0.01 |
| MJ/kg DM | Energy, MJ/kg DM² | 0.43² | 0.43² | 0.43² | 0.43² | 0.01 | <0.01 |
| Net feed production | 0.43² | 0.43² | 0.43² | 0.43² | 0.01 | <0.01 |
| Energy, MJ/kg | Karlsson et al., 2017 |

Figure 3. Delineation of the performance of humans and animals from the left panel to the right panel, showing how diet affects the performance of humans and animals. Delineation of the performance of humans and animals from the left panel to the right panel, showing how diet affects the performance of humans and animals. Karlsson et al., 2017