Digestivity and metabolizable energy intake equations of tropical ruminant forages using nutrient concentration of cattle faeces

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Introduction
- smallholders use feeds of unknown or highly variable nutritive value undermining proper nutrition
- determination of feed intake and accurate nutritive value in grazing animals is resource-intensive
- faecal collection and analysis is relatively easy
- prediction equations of feed nutritive value based on faecal nutrient concentrations would be fast, cheap and routine

Objective
- prediction equations of dry matter digestibility (DMD), digestible organic matter in dry matter (DOMD) and metabolizable energy (ME) intake of tropical feedstuffs using cattle faecal nutrient concentrations

Findings

Table 1. Apparent digestibility (arithmetic mean ± SEM, g/100 g) of diets fed to steers in three in vivo studies carried out at ILRI, Nairobi, Kenya 2014 – 2017 (n = 92)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Study N-balance</th>
<th>Tropical grasses feeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMD</td>
<td>57 ± 1.2</td>
<td>56 ± 0.9</td>
</tr>
<tr>
<td>OM digestibility</td>
<td>60 ± 1.1</td>
<td>60 ± 1.4</td>
</tr>
<tr>
<td>CP digestibility</td>
<td>15 ± 3.8</td>
<td>60 ± 1.5</td>
</tr>
</tbody>
</table>

Method
- in vivo studies with Friesian and/or Boran steers (n = 42):
  a. Protein-deficit: wheat only and with daily or bi-daily Calliandra calothyrsus supplementation
  b. Energy-deficit: Chloris gayana at 40%, 60%, 80% and 100% of maintenance energy requirement
  c. Balanced: tropical grasses (Pennisetum purpureum, Brachiaria brizantha, C. gayana) planted alone or with Lablab purpureus intercrop
  - determination of feed and faecal proximate nutrient, fibre and energy concentration, DMD, DOMD and MEI
  - faecal nutrient concentrations from a. and b. regressed against diet DMD, DOMD and MEI; c. for validation dataset
  - equations were evaluated using root mean square prediction error (RMSE) and mean error (PE)

Table 2. Equations predicting DMD and DOMD (g/100 g DM) and ME intake (MJ/day) of feedstuffs using faecal nutrient concentrations from in vivo studies carried out at ILRI, Nairobi 2014-2017 (n = 92)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Equation</th>
<th>Adj. R²</th>
<th>p-value</th>
<th>r</th>
<th>RMSE</th>
<th>PE</th>
</tr>
</thead>
<tbody>
<tr>
<td>DMD</td>
<td>53 – 0.3fDM + 0.4fNDF – 0.4fADF</td>
<td>0.06</td>
<td>0.04</td>
<td>0.32</td>
<td>4.0</td>
<td>±5</td>
</tr>
<tr>
<td>DOMD</td>
<td>29 + 0.6fNDF – 0.5fADF + 1.0fCP</td>
<td>0.10</td>
<td>0.01</td>
<td>0.37</td>
<td>4.0</td>
<td>±5</td>
</tr>
<tr>
<td>ME intake</td>
<td>75 – 1.8fDM – 1.9fADF + 1.8fCP</td>
<td>0.36</td>
<td>&lt;0.01</td>
<td>0.66</td>
<td>7.0</td>
<td>±22</td>
</tr>
</tbody>
</table>

CP = crude protein; DMD = dry matter digestibility; DM = organic matter

Discussion
- equations are weak but may be improved by using data from more test animals and more varied diets
- best predictors (whose analysis is simple, cheap and routine) were faecal DM, CP, NDF and ADF
- low PE in digestibility equations demonstrate possibility of using cattle’s faecal nutrient concentrations to predict apparent digestibility and ME content of feedstuffs

Conclusion
- ideally, these equations are developed using a balanced ration at maintenance level
- however, equations developed from a large database of in vivo animal experiments with sub-optimal diets may better reflect prevailing conditions among smallholders
- this is a first step towards development of such a database and prediction equations

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