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

Onyango, Alice Anyango[1,2*] and Goopy, John Patrick[1,3]

[1]Mazingira Center, International Livestock Research Institute, Nairobi, Kenya; [2]Maseno University, Maseno, Kenya; [3]University of Melbourne, Victoria, Australia

September 2020

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 concentration 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)

Parameter	Study		
	N-balance	Sub-maintenance feeding	Tropical grasses feeding
DMD	57 ± 1.2	56 ± 0.9	59 ± 0.7
OM digestibility	60 ± 1.1	60 ± 1.4	62 ± 0.7
CP digestibility	15 ± 3.8	60 ± 1.5	64 ± 0.9

CP = crude protein; DMD = dry matter digestibility; OM = 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

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 wih *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)

Parameter	Equation	Adj. R^2	p-value	r	RMSE	PE
DMD	53 – 0.3**fDM** + 0.4**fNDF** – 0.4**fADF**	0.06	0.04	0.32	4.0	±5
DOMD	29 + 0.6**fNDF** – 0.5**fADF** + 1.0**fCP**	0.10	0.01	0.37	4.0	±5
ME intake	75 – 1.8**fDM** – 1.9**fADF** + 1.8**fCP**	0.36	<0.01	0.66	7.0	±22

DMD, DOMD = apparent dry matter digestibility, digestible organic matter in dry matter; fADF, fCP, fDM, fNDF = faecal acid detergent fibre, crude protein, dry matter and neutral detergent fibre; ME = metabolizable energy; PE = mean (predicted value – observed value); r = correlation coefficient between actual and predicted values; RMSE = square root (mean (predicted value – observed value)^2)

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

*Alice Onyango
a.onyango@cgiar.org ● Box 30709 Nairobi Kenya ● +254 20 422 3000
Nairobi, Kenya ● ilri.org

Mazingira Centre

ILRI
INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

ILRI thanks all donors and organizations which globally support its work through their contributions to the CGIAR Trust Fund.