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Animal Nutrition and Rangeland Management in the Tropics and Subtropics
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Protein nutrition of dairy cows in the Tropics: Challenges and Perspectives

Introduction

Global milk demand is estimated to increase by 25% in the next 10 years, in particular in tropical regions. Milk production in the Tropics, however, is characterized by low yields, leading to a low nitrogen (N) use efficiency, and a high environmental burden. In this work, the aim is to highlight the main challenges and future research needs in tropical dairy protein nutrition based on results of different trials conducted by our group.

Materials and Methods

Trial 1. Use of legume forages as alternative crude protein (CP) sources in El Salvador (1)

- 8 crossbred cows (444 ± 41.2 kg live weight (LW));156 ± 100 days in milk) in a forage to concentrate ratio (70:30)
- Diets (all diets supplemented with a concentrate feed to reach a CP concentration of 130 g/kg dry matter (DM))
- Control: Sorghum silage as forage source
  Jackbean: Mixed jackbean-sorghum silage
  Cowpea: Cowpea hay and sorghum silage

Trial 2. Carbohydrate supplementation of dairy cows grazing a legume sward in Peru (2)

- 20 Brown Swiss cows (445 ± 64 kg LW; 126 ± 41 days in milk) grazing alfalfa ryegrass sward and offered maize silage feeding
- Concentrate mixture (as feed basis):
  C 1: 4.0 kg dried distillers grain with solubles (DDGS)
  C 2: 2.5 kg DDGS + 1.5 kg maize meal (MM)
  C 3: 1.0 kg DDGS + 3.0 kg MM

Trial 3. Efficiency of rumen microbial protein synthesis in underfed growing steers in Kenya (3)

- 12 Boran steers (199 ± 14 kg LW)
- Treatments: Steers were fed grass-based diet to a feeding level of 40, 60, 80, or 100% of their maintenance metabolizable energy requirement

Results

Trial 1: Milk yield and composition was not affected by the diets, but N excretion in milk and faeces was higher in jackbean.

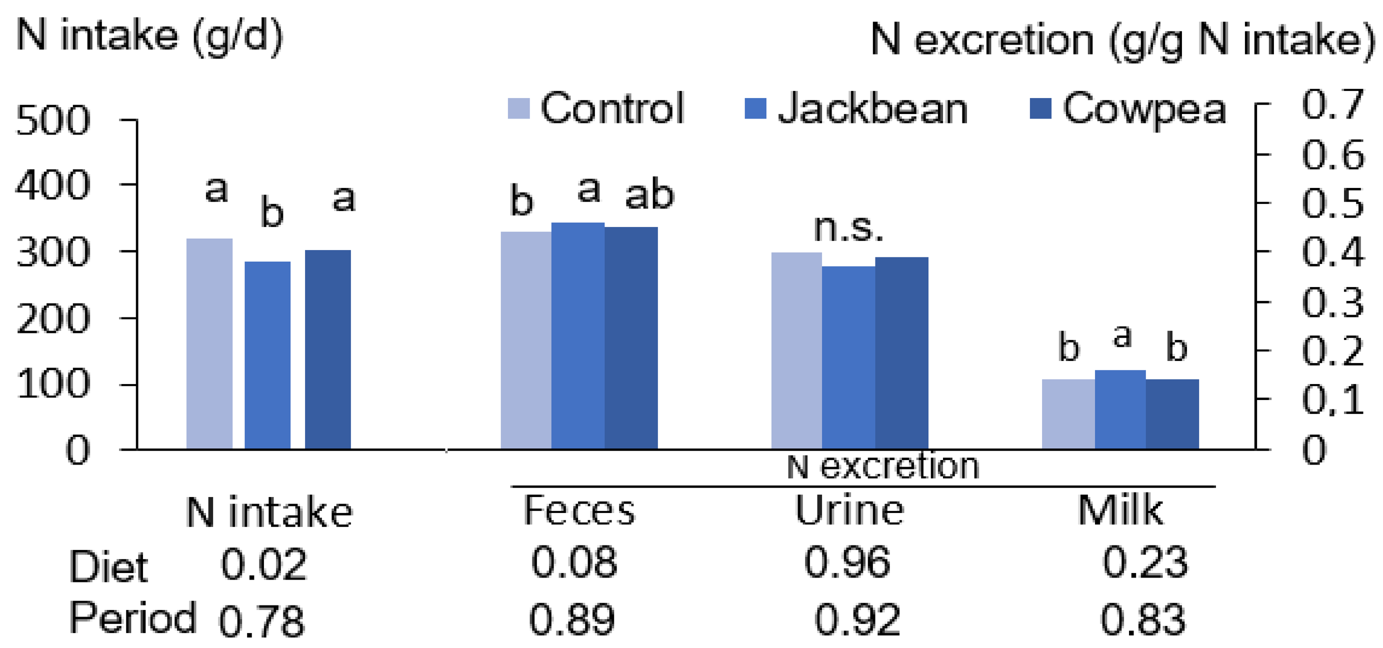

Figure 1. Nitrogen (N) partitioning of the treatments.

Trial 2: Rumen nitrogen balance decreased with increasing MM in the diet with no negative effects on milk yield. RNB close to 0 increased the efficiency of N use for milk synthesis.

Table 1. Nitrogen (N) efficiency of the treatments.

Variables	Diet 1	Diet 2	Diet 3
N intake (g/d)	475^{a} ± 97.4	439^{b} ± 68.1	325^{c} ± 59.1
RNB (g/d)	96.0^{a} ± 12.4	63.2^{b} ± 15.7	0.70^{c} ± 15.1
Milk N (g/g N intake)	0.17^{c} ± 0.02	0.18^{b} ± 0.02	0.23^{a} ± 0.03

Rumen Nitrogen Balance (RNB) = (CP intake - Microbial CP flow - undegradable CP flow)/6.25, CP: crude protein

Trial 3: Temperate feed evaluation systems overestimate the microbial CP synthesis compared with the values calculated from urinary purine derivatives.

Table 2. Estimated duodenal microbial crude protein (CP) flow at four levels (g/d).

Variables	Feed intake (% of MEm)			
	40	60	80	100
From urinary PD[1]	42.5^{c}	76.2 ^{b}	96.8^{a}	157.5^{a}
From ME intake[2]	127^{d}	189^{c}	221^{b}	276^{a}

PD: purine derivatives, MEm: metabolizable energy requeriments for maintenance.
[1]Chen & Orskov (2003); [2]GfE (2001).

Conclusion

The main challenge in tropical production systems is to achieve sustainable intensification of dairy farming to meet future demand and enhance self-sufficiency in milk production. Therefore, future research should be focused on:

- Characterising and encouraging the use of local protein sources replacing protein concentrates in dairy cattle diets;
- Awarding differences in rumen protein turnover and protein requirements of dairy cattle under tropical conditions; and
- Developing and validating scientific methodology for an accurate evaluation of tropical feedstuffs.

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