Effects of tropical legumes with contrasting tannin contents and mixtures of them on *in vitro* ruminal fermentation and methanogenesis

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Introduction Previous *in vitro* experiments have showed that the supplementation of a low-quality grass diet with *Arachis pintoi* or *Cratylia argentea* (legumes low in tannins) enhanced ruminal fermentation and methane release, whereas the supplementation with *Calliandra calothyrsus* (rich in tannins) decreased methane release and suppressed organic matter (OM) degradation and N turnover (Hess *et al*., 2003). It was hypothesised that a mixture of tanniniferous legumes with legumes free of or low in tannins would result in a methane-suppressing effect but without impairing ruminal nutrient degradation.

Materials and methods Three *in vitro* experiments were performed with an 8-fermenter RUSITEC-apparatus (Rumen simulation technique) to evaluate the fermentation characteristics of legumes with contrasting contents of condensed tannins and their mixtures. In every experiment, four basal diets consisting only of legumes were evaluated in four replicates. The daily dry matter (DM) supply to the fermenters was maintained constant at 15 g. In experiment 1, the 4 legumes *A. pintoi*, *C. argentea*, *C. calothyrsus* and *Flemingia macrophylla* were compared. In experiment 2, the effects of a partial or complete replacement (0, 0.25, 0.5 and 1 of total of diet DM) of *C. calothyrsus* by *C. argentea* were investigated. In experiment 3, the influences of a partial replacement (0.5 of diet DM) of *F. macrophylla* by *C. argentea*, *C. calothyrsus* or by a mixture of both were evaluated.

Results In experiment 1, apparent degradation of OM and crude protein (CP) was highest for *A. pintoi*, intermediate for *C. argentea* and lowest for *F. macrophylla* and *C. calothyrsus* ($p<0.05$). Methane release relative to OM degraded was highest for *A. pintoi* and *C. argentea*, intermediate for *F. macrophylla* and lowest for *C. calothyrsus* ($p<0.05$). In experiment 2, apparent degradation of OM and methane release relative to OM degraded were lowest with *C. calothyrsus* alone and increased linearly ($p<0.001$) with increasing proportion of *C. argentea*. When 0.25 or 0.5 of *C. calothyrsus* was replaced by *C. argentea*, only minor changes were observed in N turnover. However, the complete replacement of *C. calothyrsus* enhanced N turnover. With the exception of methane release, which was suppressed ($p<0.05$), only minor changes in fermentation were observed when 0.5 of *F. macrophylla* was replaced by *C. calothyrsus* in experiment 3. In contrast, the inclusion of *C. argentea* increased ($p<0.05$) apparent organic matter degradation and methane release per gram of OM degraded. When 0.5 of *F. macrophylla* was replaced by *C. calothyrsus* no changes in apparent CP degradation and ruminal N turnover occurred ($p>0.05$). However, the inclusion of *C. argentea* resulted in an improvement of CP degradation and N turnover.

Conclusions The results from the present study confirmed the high nutritional value of *A. pintoi* and *C. argentea* and the potential of tannin-rich legumes to suppress methanogenesis. The shrub legume *F. macrophylla* seems to have a slightly higher feeding value than *C. calothyrsus* and was less effective in suppressing methanogenesis. The results also suggest that the use of mixtures of *C. calothyrsus* and *C. argentea* is a way to mitigate methane emission but simultaneously affects the nutritional value of the diet. This is in contrast with the observations made in a previous experiment (Hess *et al*., 2004) where the supplementation of a low-quality grass with a mixture of these legumes increased OM degradation without enhancing methane emission relative to OM degraded. Therefore we postulate that the effects of legume mixtures on rumen fermentation not only depend on the quality and proportion of the different legumes, but also on the remaining components of the diet. If this is so, the evaluation of legume mixtures has to be done in combination with grasses which represent the most important diet ingredient for ruminants in tropical smallholder livestock systems.

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References

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