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Use of the gas production technique to investigate responses of supplementing low quality forages: 1. *In vitro* interactions

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Introduction Nitrogen-deficient fibrous crop residues are widely used as basal diets in less developed countries, particularly in dry seasons when alternative feeds are often in short supply. One approach to improving animal performance on crop residue based diets is to include a supplement of improved quality feed to provide fermentable protein and energy. There are no established *in vitro* methods for investigating interactions between feeds, but the *in vitro* gas production method shows promise in this regard. This paper describes the interactions observed *in vitro*; an accompanying paper describes *in vivo* responses to supplementation and relationships between *in vitro* and *in vivo* data.

Materials and methods Feeds: wheat straw (WS; crude protein 34 g kg^{-1} DM) as roughage, high temperature dried grass (HTDG) and lucerne (HTDL) were used as supplements. Proportions of supplement were selected to mimic those achieved in *in vivo* study and to extend the range to higher levels of supplementation (up to 100% supplement). Feed mixtures were fermented in N-rich and N-free media using a fourfold diluted inoculum and the France *et al.* (1993) model fitted.

Results The N-energy balance of feed mixtures was investigated by plotting the difference in cumulative gas production after 48 h incubation against the proportion of supplement in the mixture (0 = all straw; 1 = all supplement). This is illustrated for HTDG in Figure 1, the data for HTDL were very similar. Difference in gas production was greatly reduced by increasing supplement up to about 0.5, but further increases had a declining effect. Therefore fermentable N and energy appeared to be close to balance when the proportion of HTDG or HTDL was about 0.5.

Figure 1 Difference in gas production (GP) at 48 h incubation for wheat straw + grass mixtures fermented in N-rich and N-free media

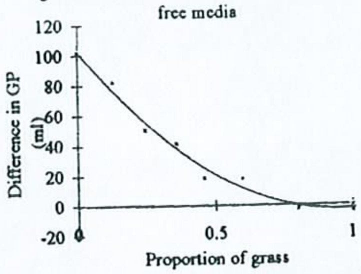
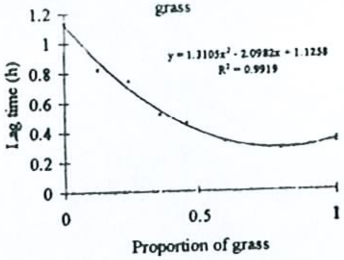


Figure 2 Proportion of grass versus lag time for fermented wheat straw + grass



In N-free medium, non-linear relationships were observed between cumulative gas production for WS and either supplement, indicating interactions occured between the feeds. In N-rich medium linear relationships were observed between cumulative gas production and the proportion of supplement, but the fitted France et al. (1993) model indicated that there were curvilinear relationships between the proportion of HTDG and the lag time (illustrated in Figure 2) and rate constant (c). For the gas pool size and the rate constant (b), the relationship was approximately linear. Similar results were obtained for HTDL supplementation, although there was an apparent slight deviation from linearity in the relationship between rate constant (b) and the proportion of HTDL.

Conclusions The *in vitro* data indicated that the straw + supplement mixtures reach balance between fermentable N and energy when a proportion of about 0.5 of supplement was used. Interactions between the feeds were observed when fermented in the N-free medium, presumably due to N provided by the supplement. In N-rich medium interactions were apparent in the lag time and rate constant (c). Further work is required to calibrate interactions of this type against *in vivo* responses.

References France J, Dhanoa M S, Theodorou M K, Lister S J, Davies D R and Issac D (1993) A model to interpret gas accumulation profiles associated with *in vitro* degradation of ruminant feeds. Journal of Theoretical Biology 163: 99-111.