Methane production in warmblood ponies fed either a roughage only or a roughage plus concentrate diet

O Dansen[1], W F Pellikaan[1], W H Hendriks[1,2], J Dijkstra[1], M P T Jacobs[1], H Everts[2], D A van Doorn[2]
[1]Animal Nutrition Group, Wageningen University, P.O. Box 338, 6700 AH, Wageningen, The Netherlands, [2]Department of Farm Animal Health, Faculty of Veterinary Medicine, Utrecht University, P.O. Box 80.151, 3508 TD, Utrecht, The Netherlands *Email:olga.dansen@ziggo.nl*

Introduction Atmospheric methane concentrations have increased considerably since the pre-industrial era, mainly caused by anthropogenic contributions (Solomon *et al.*, 2007). For equines, enteric methane emissions are defined by the Tier 1 method and are estimated at 18 kg methane/head/year at live weight of 550 kg (IPCC, 2006). Reduction of methane emission from horses may be achieved by dietary interventions, e.g. by inclusion of concentrates in their diet. It is hypothesized that diets containing large amounts of concentrates with highly available starch sources may cause less methane production compared to diets containing mainly roughage, due to more enzymatic digestion pre-caecally and less fermentation in the hindgut. However, roughage rich rations are preferred from a health and welfare point of view (Elia *et al.*, 2010). Potential dietary interventions to reduce methane emission by horses may therefore conflict with optimization of the animals' health and welfare. Despite the large horse population worldwide, quantitative methane emission data on horses is scarce. The main objective of this study was to quantify methane production in warmblood ponies either receiving a roughage only (R) diet or a diet containing roughage plus concentrate (RC).

Material and methods In order to quantify methane production from warmblood ponies in relation to the energy intake of two different diets, a cross-over design with 2 treatments involving 4 mature warmblood pony geldings (BW 230 ± 10.5 kg; mean ± s.e.) was used. Ponies were fed at maintenance level with 2 iso-energetic diets (on NEm basis), either roughage only (R) (5.05 kg DM/day) or a combination of roughage and concentrate (RC) (2.52 kg DM hay/day plus 1.11 kg DM concentrate/day). For both diets the same grass hay was used (DM 898 g/kg; NEm 4.47 MJ/kg DM) and a commercial grain mix was used in the RC diet (DM 890 g/kg; NEm 9.64 MJ/kg DM). The experiment involved 2 periods of 14 days each; started with 10 days of adaptation, followed by 4 days of housing in large climate controlled respiration chambers (CRCs) (6m × 3m × 2m). Ponies were housed in pairs in CRCs and each chamber was fitted with a grid fence to separate the ponies, but the design was such to allow a pair to interact with each other. Oxygen (O_2) consumption, carbon dioxide (CO_2) production, and methane (CH_4) production were measured. Heat production (HP) was estimated by use of indirect calorimetry. Diet intake and faecal output were measured quantitatively to determine digestibility of the individual animals. Gaseous exchange measurements were averaged per period for each diet (i.e. 2 chambers as experimental units). Diet digestibility was determined for each individual pony (i.e. 4 individual ponies as experimental units). The General Linear Model (GLM) procedure in SAS (version 9.2, SAS Institute, Cary, NC, USA) was used to analyze both gaseous exchange and diet digestibility. The model for gaseous exchange included diet and period as fixed effects. Pony was included in this model for analysis of diet digestibility.

Results Ponies quickly adapted to housing in the respiration chambers, were apparently healthy during the whole experiment and no stereotypical behaviour was observed. Intake of NEm was equal for both rations (22.3 ± 0.07 MJ/day). Organic matter digestibility was higher ($P = 0.006$) for the RC diet compared with diet R (55.6 and 47.2%, respectively). Methane production (L/pony/day) was higher ($P = 0.014$) on the R diet (29.8 ± 0.11; mean ± s.e.) compared to the RC diet (23.2 ± 0.11). Methane production expressed in L/kg $BW^{0.75}$/day and as a percentage of DE was decreased for the RC-group by 21% (0.50 vs. 0.39 L/kg $BW^{0.75}$/day) ($P = 0.064$) and 12% (3.18 vs. 2.79 % of DE) ($P = 0.113$), respectively. Heat production, oxygen consumption and carbon dioxide production were not affected ($P > 0.304$) by diet. Diurnal patterns of CH_4 production and HP showed similar patterns for both diets. Methane production increased slightly after feeding and was lower for the RC diet at all timepoints throughout the day. For both diets heat production was higher post feeding than pre feeding and decreased again approximately 3 hours after feeding.

Conclusions Our results show that iso-energetic addition of concentrate to roughage diets reduces methane production in ponies. This confirms our hypothesis that diets containing larger amounts of concentrates with highly available starch sources cause less methane production compared to diets containing mainly roughage, due to more enzymatic digestion pre-caecally and less fermentation in the hindgut.

References

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