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Postprandial Kinetics of Dissolved Hydrogen in the Rumen of Cows Fed Nitrate and/or Linseed Oil

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Linseed oil and nitrate fed alone or in association significantly reduced methane (CH_4) emissions from cows (Guyader *et al* 2014, this conference). To have a better insight of the mechanisms involved in CH_4 mitigation by these additives, we focused on the hydrogen (H_2) pool, a key element regulating methanogenesis in the rumen. We hypothesized that linseed oil and nitrate differently affect the rumen H_2 pool. Linseed oil may decrease H_2 production via a toxic effect on protozoa, and nitrate may use H_2 at the expense of methanogens.

Four cows were randomly assigned to 4 dietary treatments in a 4 x 4 Latin square design: 1) control diet (CON), 2) control diet with 4% linseed oil (LIN), 3) control diet with 3% calcium nitrate (NIT), and 4) control diet with 4% linseed oil and 3% calcium nitrate (LIN+NIT) (for more details see Guyader *et al* 2014, this conference). The kinetics of dissolved H_2 concentrations in rumen fluid were measured using a H_2 sensor (H_2-500, Unisense, Denmark). The sensor was introduced through the rumen cannula and placed at the bottom of the ventral sac before the morning feeding and data were continuously collected up to 6 hours postfeeding. Data were analyzed in repeated time using the MIXED procedure of SAS (SAS, 2009) with a model including period, diet, hour and diet x hour interaction as fixed effects, and cow as random effect.

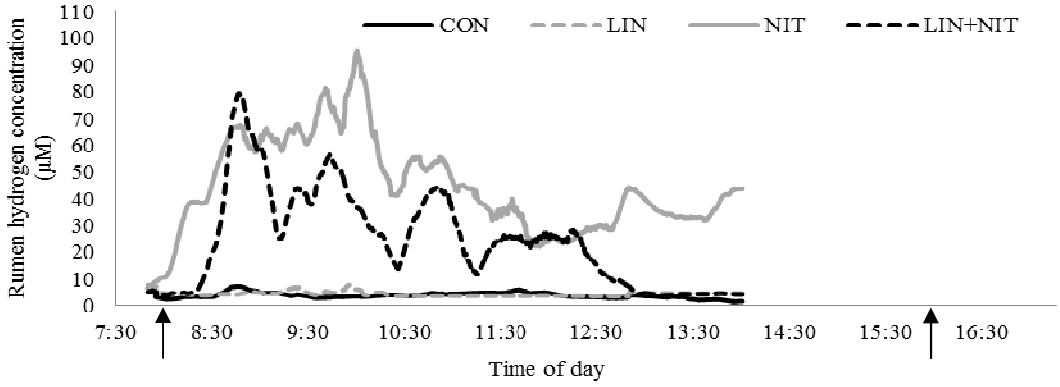

Figure 1. Postfeeding pattern of rumen dissolved H_2 concentrations from dry cows fed nitrate and/or linseed oil. Black arrows indicate time of feeding

With CON and LIN, the pool of dissolved H_2 in the rumen remained low and stable after feeding ($P>0.05$, Figure 1), showing that the equilibrium between production and use of H_2 was unaffected. Then, it is a lower H_2 production and consequently a concomitant lower H_2 availability for methanogens which may explain the CH_4 mitigation effect of linseed oil. In contrast, compared to CON, NIT induced a postprandial rise of rumen H_2 concentration ($P<0.05$), confirming that nitrate decreased CH_4 not only because it is a H_2 sink but also through its inhibitory action on methanogens. This effect is alleviated by associating nitrate with linseed oil as shown by the lower build-up of H_2 concentration with LIN+NIT. By studying for the first time the dynamic of rumen dissolved H_2 concentrations, we confirmed our hypothesis that linseed oil and nitrate have different modes of action on the rumen H_2 pool, and that the mechanisms of CH_4 mitigation by those compounds involve different pathways.

J. Guyader is the recipient of an INRA-Région Auvergne PhD scholarship.

Guyader J., Eugene M., Doreau M., Rochette Y., Morgavi D.P. and Martin C. (2014). Proc. Aust. Soc. Anim. Prod.

Email: cecile.martin@clermont.inra.fr This work was funded by InVivo NSA.