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Comparison of *in vitro* and *in vivo* methane production from improved and traditional rations of dairy cows in India

Degree of Organic Agriculture and Food Systems

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SUMMARY

This study analyzed differences in methane (CH_4) emissions from Indian dairy rations traditional (BRB) and improved (ARB) ration balancing using *in vivo* and *in vitro* techniques. The CH_4 emitted from Holstein–Friesian cross breed cows (n = 35) that received BRB and ARB diets in two subsequent periods was measured by sulphur hexafluoride tracer technique by National Dairy Development Board (NDDB) in India. Additionally, samples of the same diets of were analyzed with Hohenheim gas test (HGT) [BRB (n = 35) and ARB (n = 35) diets] at NDDB laboratory and University of Hohenheim (UHOH), Germany, to explore the potential of using *in vitro* techniques to estimate CH_4 production. The parameters measured with HGT were gas production (GP) (ml/mg truly degraded substrate), CH_4 production (ml/g dry matter (DM)), substrate degradability (mg/mg substrate) and short chain fatty acids (SCFA) concentrations in rumen fluid (µmol/ml) after incubation of the sample in buffered rumen fluid for 24 hours. At UHOH, GP ($P < 0.01$) and total SCFA concentration ($P = 0.04$) were lower in ARB diets, whereas the partitioning factor (mg truly degraded substrate/ml GP) was higher in ARB than in BRB diets ($P = 0.02$). Thus ARB diet helped to increase the degradability of the feed without adverse effect on the rumen fermentation, as no external supplementation of the feed to the improved diet was conducted. However, at NDDB only GP was lower in ARB diets ($P < 0.01$). As a result, weak relationship was obtained on the inter-laboratory comparison with $R^2 = 0.4$ for GP (ml/380 mg DM) and $R^2 = 0.2$ for CH_4 production (ml/380 mg DM). Nevertheless, no decrease in CH_4 production (ml/g DM) was reported in ARB diets by *in vitro* as well as by *in vivo* techniques, thus contradicting the hypothesis. Thus the individual CH_4 emissions (ml/g DM) were not reduced on balancing the diet however it can be expected CH_4 (g/kg milk yield) decreased. The relationship between *in vitro* and *in vivo* CH_4 production (ml/g DM) were weak. Thus, prediction of *in vivo* CH_4 results from *in vitro* CH_4 can be difficult. Nevertheless, HGT can be used to measure potential CH_4 emissions from ruminants as it allows for the screening of large sets of samples.