Ruminant Nutrition 4: Methane

354 Relationships between enteric methane emission, nutrient digestibility, and production efficiency in lactating dairy cows: A meta-regression. L. F. Martins*[1], N. Stepanchenko[1], A. Bannink[2], C. Benchaar[3], A. F. Brito[4], C. Cajarville[5], M. M. Campos[6], A. L. Carroll[7], S. Colombini[8], G. F. S. Congio[9], L. Crompton[10], S. C. da Silva[9], M. M. Della Rosa[11], J. Dijkstra[12], L. Dong[13], M. Eugène†[14], P. Fant[15], G. Giagnoni[16], K. Goossens[17], P. Huhtanen[18], A. Jonker[19], E. Kebreab[20], P. J. Kononoff[21], M. Kreuzer[22], P. Lund[16], M. Maigaard[16], C. Martin[23], R. M. Maurício[24,25], G. D. Melo[26], A. M. Moura[27], C. Muñoz[28], M. Niu[22], M. Paz Tieri[29], N. Peiren[17], D. Qiyu[30], M. Ramin[15], R. Rauch[26], C. K. Reynolds[31], P. Ricci[32], A. Rytz[26], F. A. P. Santos[33,34], A. L. Silva[35], T. R. Tomich[6], S. van Gastelen[2], L. Vandaele[36], M. Wang[37], M. R. Weisbjerg[38], S. R. O. Williams[39], T. Yan[40], and A. N. 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Interest in selecting cows for low enteric CH_4 emission has raised concerns about potential tradeoffs with nutrient digestibility and lactational performance. The objective was to quantify relationships among enteric CH_4 emission, production variables, and nutrient digestibility in dairy cows. Individual cow data (n = 5,146) from 163 studies were compiled. Cows averaged (mean ± SD) 22.7 ± 4.8 kg/d DMI, 32.5 ± 8.3 kg/d ECM, and 597 ± 109 kg BW. Response variables were daily enteric CH_4 production (CH_4P; g/d), CH_4 yield (CH_4Y; g/kg DMI), and CH_4 intensity (CH_4I; g/kg ECM). Linear mixed models included centered predictors, DMI (% BW) as a covariate, and study as random effect. Effect sizes reported here represent the expected change in each CH_4 response variable per unit increase in the predictor (e.g., kg/d, % BW, %). Methane production increased with DMI (% BW; 25.8 ± 3.51 g/d), milk yield (MY; kg/d; 1.8 ± 0.28 g/d), milk fat (% and kg/d; 21.6 ± 3.19 and 95.4 ± 6.57 g/d), and milk true protein (kg/d; 95.9 ± 9.11 g/d), but decreased with feed efficiency (FE; kg/kg; −35.7 ± 7.80 and −15.5 ± 8.44 g/d on MY and ECM bases; $P \leq 0.07$). Methane yield decreased with MY (−0.054 ± 0.012 g/kg) and milk true protein (kg/d; −1.77 ± 0.407 g/kg) but increased with milk fat (% and kg/d; 0.95 ± 0.109 and 1.24 ± 0.294 g/kg; $P < 0.01$). Methane intensity decreased with DMI (% BW; −1.73 ± 0.154) and FE (kg/kg; −7.81 ± 0.278 and −8.79 ± 0.304 g/kg on MY and ECM bases; $P \leq 0.02$). Methane production was positively associated ($P \leq 0.01$) with OM (%; 1.25 ± 0.484 g/d), NDF (%; 1.64 ± 0.273 g/d), and ADF digestibility (%; 1.86 ± 0.324 g/d), and negatively associated ($P < 0.01$) with starch (%; −4.07 ± 1.387 g/d), ether extract (%; −1.33 ± 0.397 g/d), and CP digestibility (%; −1.43 ± 0.376 g/d). Similar but smaller effects were observed for CH_4Y and CH_4I (−0.13 to 0.08 g/kg). In conclusion, increased milk production reduced both CH_4Y and CH_4I, whereas improved FE reduced both CH_4P and CH_4I. Selection for production may reduce emission intensity despite the positive relationships between OM and fiber digestibility and CH_4P.

Key Words: milk production, greenhouse gas, feed efficiency, phenotype

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