Enteric methane emission models for diverse beef cattle feeding systems in South-east Asia: A meta-analysis

T.P. Tee[a], Y.M. Goh[a], M.H.M. Zainudin[a], S.C.L. Candyrine[a], K. Sommart[b], K. Kongphitee[b], W. Sumamal[c], I. Phaowphaisal[c], R. Namsilee[c], W. Angthong[c], S. Sunato[c], O. Keaokliang[c], K. Maeda[d], N.V. Thu[e], T.T. Trung[e], N.T.K. Dong[f], A. Purnomoadi[g], M. Kurihara[h], A. Jayanegara[i], K. Higuchi[h], Y. Kobayashi[h], F. Ohtani[h], H. Abe[h], F. Terada[j], H. Kumagai[k], H. Matsuyama[l], I. Nonaka[h], N. Takusari[h], N. Shiba[h], K. Hosoda[h], T. Suzuki[d,h], Y. Kamiya[h], T. Nishida[m], K. Hayasaka[h], M. Shibata[h], M. Wang[n], Z.L. Tan[n], R. Wang[n], E. Kebreab[o], H.J. van Lingen[p], A.N. Hristov[q], J.B. Liang[a]

[a] Universiti Putra Malaysia, [b] Khon Kaen University, Thailand, [c] Ruminants Feeding Standard Research and Development Center, Thailand, [d] JIRCAS, Japan, [e] Can Tho University, Viet Nam, [f] Tay Do University, Viet Nam, [g] Diponegoro University, Indonesia, [h] NARO, Japan, [i] IPB University, Indonesia, [j] Tohoku University, Japan, [k] Kyoto University, Japan, [l] Yamagata University, Japan, [m] Obihiro University Japan, [n] Institute of subtropical Agriculture, China, [o] University of California, Davis, USA, [p] Wageningen University & Research, the Netherlands, [q] The Pennsylvania State University, USA

Abstract

Prediction models for enteric methane (CH_4) emissions from beef cattle proposed by various groups may not perform with similar accuracy for the low- and middle-income countries in South-east Asia (SE-Asia) because beef cattle in these countries are raised under different climatic conditions with diverse feeding systems, and have different CH_4 emission characteristics. The objectives of this study were to: i) predict CH_4 emission (g d^{-1} $animal^{-1}$), yield [g kg^{-1} dry matter intake; DMI) $^{-1}$], intensity [g kg^{-1} average daily gain) $^{-1}$], and CH_4 conversion factor (Y*m*) using an intercountry database of individual animal records from SE-Asia; ii) evaluate the impact of different dietary forage contents (all-, high- and low-forage) representing the diverse feeding systems on CH_4 emission, yield, intensity and Y*m* in SE-Asia; and iii) cross-validate equations from this study with published data. A total of 398 individual animal observations of beef cattle from SE-Asia were used for this analysis. Linear models developed by incrementally adding covariates revealed that CH_4 emission model using only DMI fitted to all data had a root mean square prediction error (RMSPE) of 16.9%. Subsets containing data with 100% forage in the diet (all-forage), 50–85% (high-forage) and < 50% (low-forage) had an RMSPE of 16.5%, 14.7%, and 17.4%, respectively. Linear multiple equation based on DMI and dietary NDF concentration (DMI + NDF_C, RMSPE = 15.2%; all-data) improved prediction accuracy over that of DMI alone. The DMI + NDF_C models for all-forage (RMSPE = 14.6%) and high-forage subsets (RMSPE = 13.3%) except for low-forage (RMSPE = 16.4%), improved the precision and accuracy of CH_4 emission prediction. Methane yield and CH_4 emission intensity could not be reliably modelled with the current database. The present study provides improved CH_4 prediction models for beef cattle managed under diverse feeding systems in SE-Asia and affirmed that region-specific models are needed to reliably predict beef cattle CH_4 emission at national or regional levels, particularly for low- and middle-income countries.

References/ Publications

Anim. Feed Sci. Technol. 294:115474. doi: 10.1016/j.anifeedsci.2022.115474