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Factors Affecting Methane Enteric Emission and Predictive Models for Dairy Cows

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Supplemental Materials

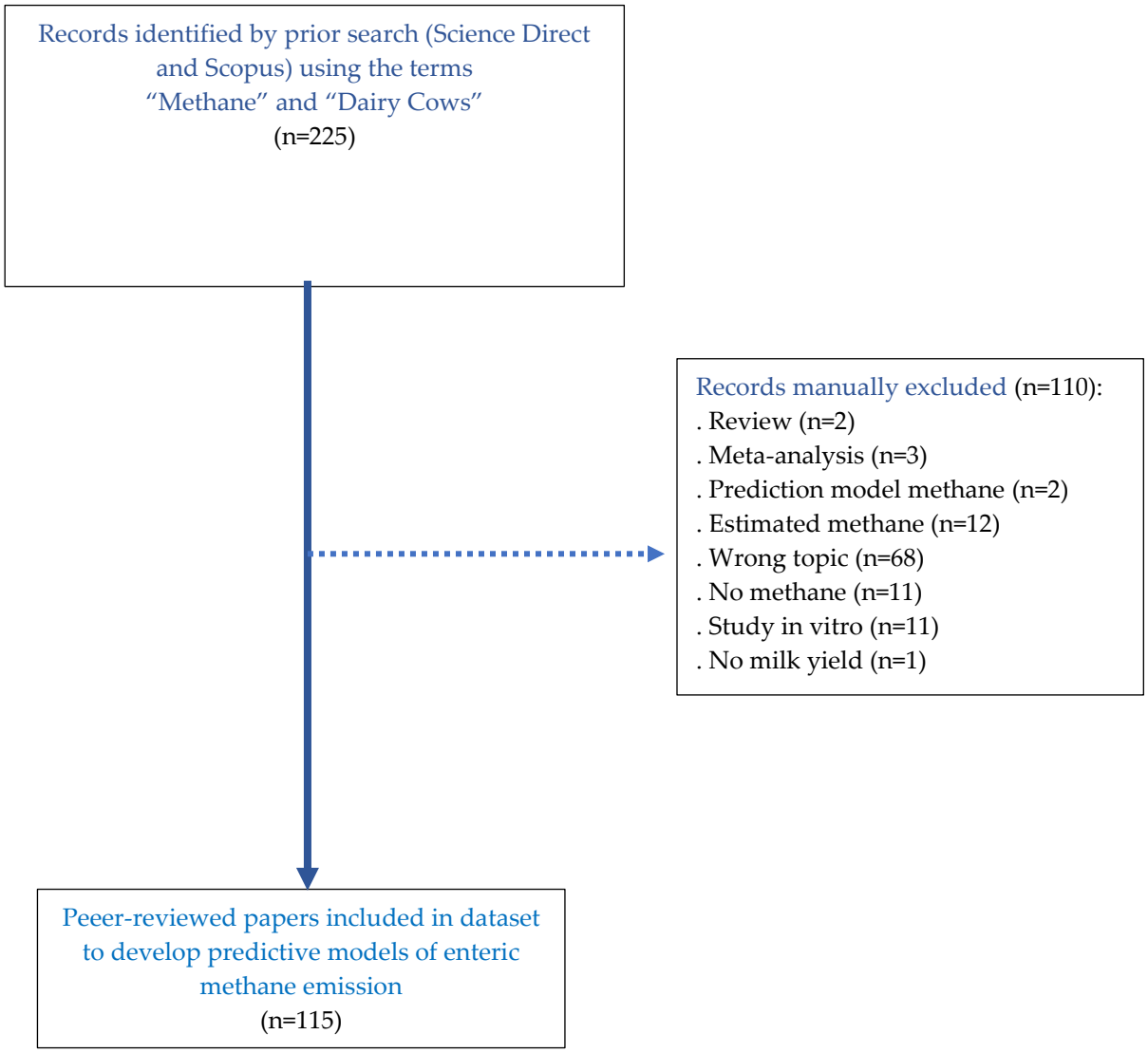

Figure S1. Flowchart showing exclusion/inclusion criteria for selection of peer-reviewed papers used included in dataset to develop predictive models of enteric methane emission in dairy cows.

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Data S2. References used to develop models for predicting the enteric methane emission from lactating dairy cows.

Table S1. External models evaluated for predicting enteric methane emission (EME; g/cow/day) of lactating dairy cows

Models	Equation[1]
Kirchgeßner et al. (1995)	$EME = 10.0 + 4.9 \times MY + 1.5 \times BW^{0.75}$
Yan et al. (2000) Model	$EME = [3.23 + 0.055 \times GEI]/ 0.05565$
Corré (2002)	$EME = [50.0 + 0.01 \times MY \times 365]/365 \times 1000$
Mills et al. (2003) Model I	$EME = [5.93 + 0.92 \times DMI] / 0.05565$
Model II	$EME = [56.27 – (56.27+ 0) \times e^{[-0.028 \times DMI]}]/ 0.05565$
Model III	$EME = [45.98 – (45.98 + 0) e^{[-0.003 \times MEI]}]/ 0.05565$
IPCC (2006) Tier II	$EME = [0.065 \times GEI] / 0.05565$
Ellis et al. (2007) Model I	$EME = [3.23 + 0.809 \times DMI] / 0.05565$
Model II	$EME = [3.14 + 2.11 \times NDFI] / 0.05565$
Model III	$EME = [4.08 + 0.068 \times MEI] / 0.05565$
Model IV	$EME = [1.21 + 0.059 \times MEI + 0.093 \times Forage] / 0.05565$
Model V	$EME = [8.56 + 0.139 \times Forage] / 0.05565$
Model VI	$EME = [2.16 + 0.493 \times DMI – 1.36 \times ADFI + 1.97 \times NDFI] / 0.05565$
Model VII	$EME = [5.87 + 2.43 \times ADFI] / 0.05565$
Moate et al. (2011) Model I	$EME = [24.51 – 0.0788 \times EE] \times DMI$
Model II	$EME = [e^{[3.15 -0.0035 \times EE]}] \times DMI$
Model III	$EME = 2.54 + 19.14 \times DMI$
Nielsen et al. (2013) Model I	$EME = [1.36 \times DMI – 0.125 \times FA – 0.02 \times CP + 0.017 \times NDF] / 0.05565$
Model II	$EME = [1.23 \times DMI – 0.145 \times FA + 0.012 \times NDF] / 0.05565$
Model III	$EME = [1.39 \times DMI – 0.091 \times FA] / 0.05565$
Model IV	$EME = [1.26 \times DMI] / 0.05565$
Model V	$EME = [738 \times DMI\_BW – 0.145 \times FA + 0.013 \times NDF] / 0.05565$
Ramin and Huhtanen (2013) Model I	$EME = [62 + 25 \times DMI] \times 16.0 / 22.4$
Model II	$EME = [20 + 35.8 \times DMI – 0.5 \times DMI^2] \times 16.0 / 22.4$
Storlien et al. (2014) Model I	$EME = [– 1.47 + 1.28 \times DMI] / 0.05565$

Model II	EME = [– 2.76 + 3.74 × NDFI] / 0.05565
Model III	EME = [6.80 + 1.09 × DMI – 0.15 × FA] / 0.05565
Moraes et al. (2014) Model I	EME = [3.247 + 0.043 × GEI] / 0.05565
Model II	EME = [0.225 + 0.042 × GEI + 0.125 × NDF% – 0.329 × EE] / 0.05565
Charmley et al. (2016) Model I	EME = 38.0 + 19.22 × DMI
Model II	EME = [2.14 + 0.058 × GEI] / 0.05565
Santiago–Juarez et al. (2016) Model I	EME = [27.992 + 0.054 × NDF – 0.909 × ME – 0.295 × EE]/ 0.05565
Model II	EME = [29.847 – 0.979 × ME]/ 0.05565
Model III	EME = [3.911 + 0.128 × MY + 1.274 × MP + 2.166 × MF]/ 0.05565
Model IV	EME = [8.967 + 0.141 × MY + 1.626 × MP + 1.919 × MF + 0.054 × NDF – 0.707 × ME]/ 0.05565
Model V	EME = [11.496 + 0.134 × MY + 1.514 × MP + 1.952 × MF – 0.726 × ME]/ 0.05565
Model VI	EME = [–2.483 + 2.132 × MF + 0.069 × NDF – 0.376 × ME– 0.185 × EE + 0.842 × DMI]/ 0.05565
Model VII	EME = [–2.639 + 2.149 × MF + 0.068 × NDF – 0.406 × ME + 0.840 × DMI]/ 0.05565
Model VIII	EME = [–6.123 + 2.342 × MF – 0.573 × MP + 0.072 × NDF – 0.351 × ME – 0.232 × EE + 0.784 × DMI + 0.009 × BW]/ 0.05565
Model IX	EME = [–7.381 + 2.249 × MF + 0.071 × NDF – 0.407 × ME + 0.787 × DMI + 0.009 × BW]/ 0.05565
Model X	EME = [–5.124 + 2.300 × MF + 0.840 × DMI]/ 0.05565
Model XI	EME = [4.544 + 0.773 × DMI]/ 0.05565
Niu et al. (2018) Model	EME = – 0.65 + 12.4 × DMI – 8.78 × EE + 2.10 × NDF% + 16.1 × MF + 0.148 × BW
IPCC (2019) Tier II	EME = [Y_M × GEI] / 0.05565
Eugène et al. (2019) Model	EME = DOMI × MCFe × 0.001
Ribeiro et al. (2020) Model I	EME = [4.15 + 0.822 × DMI]/0.05565
Model II	EME = [3.35 + 0.047 × GEI]/0.05566

[1]MY = milk yield (kg/d); BW = body weight (kg); GEI = gross energy intake (MJ/d); DMI = dry matter intake (kg/d); MEI = metabolizable energy intake (MJ/d); NDFI = neutral detergent fiber intake (kg/d); Forage = forage (% of DM); ADFI = acid detergent fiber intake (kg/d); EE = ether extract (% of DM); FA = fatty acid (g/kg DM); CP = crude protein (% of DM); NDF = neutral detergent fiber (g/kg DM); DMI_BW = dry matter intake relative to BW (g/kg); NDF% = neutral detergent fiber (% of DM); ME = metabolizable energy (MJ/kg DM); MP = milk protein (%); MF = milk fat (%); Y_M = 0.057 if MY > 8500 kg/cow/year, NDF ≤ 35 % DM and DE ≥ 70%, Y_M = 0.06 if MY > 8500 kg/cow/year, NDF ≥ 35 % DM and DE ≥ 70%, Y_M = 0.063 if MY > 8500 kg/cow/year, NDF ≤ 37 % DM and DE ≥ 70%, and Y_M = 0.065 if MY < 5000 kg/cow/year, NDF > 38 % DM and DE ≤ 62%, DOMI = digestible organic matter intake (kg/d); and MCFe = enteric methane conversion factor (expressed in DOMI converted to CH4).

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Data S3. Reference of external models evaluated for predicting enteric methane emissions of lactating dairy cows.