**Application:** The diversity in direct methane emissions (kg/year) shown here highlights the complexity in modelling enteric fermentation across all stages of the animals lifetime and may lead to greater emphasis on the use of multi-factor enteric methane prediction equations in whole farm beef production systems.

**Introduction:** Ruminant production systems constitute a significant source of anthropogenic greenhouse gas (GHG) emissions, the principal cause of global warming and climate change. GHG emissions are typically assessed using modelling approaches such as life cycle assessment (LCA) and these models incorporate equations to predict methane (the principal GHG) emissions derived from enteric fermentation. Dry matter intake is recognised as a key driver of enteric methane emissions and a range of equations have been developed to predict enteric methane (Ellis *et al.* 2007). The aim of this present study was to compare enteric methane emissions (kg/year) in a modelled beef herd for a number of published enteric methane prediction equations. The herd level analysis was conducted using the Grange Beef Systems Model (GBSM; Crosson *et al.* 2006).

**Materials and Methods:** The GBSM was populated as aspring-calving suckler calf-to-beef farm system using cross-bred cows mated to late-maturing beef sires with all cow replacements bred on farm. The farm system incorporated a farmed area of 40 ha, two silage cuts (29th May and 24th July) and a mean calving date of 6th March with inorganic fertiliser application of 131 kg N / ha. Diets fed comprised a mix of grass, grass silage and concentrate with feeding activities quantified monthly to account for seasonal variation in diet composition. Calves were single-suckled at grass and weaned in October before a 112-day indoor winter feeding period on a grass silage + concentrate diet. Following this indoor feeding period, animals were turned out to pasture in March of their second year. Heifers not required for replacing cows culled from the breeding herd were finished at pasture at 19.5 months of age (330 kg carcass weight). Steers were housed for a second winter, fed a diet of grass silage + concentrates and finished at 22.5 months of age (389 kg carcass weight). Direct methane emissions derived from enteric fermentation were modelled using seven prediction equations (Table 1) to reflect a range of diet and stock types.

**Results:**Direct methane outputs across methodologies varied in both total emissions and within stock types (Table 1). Relative to Yan *et al.* (2009; the baseline prediction equation used in GBSM), total direct emissions ranged from 90% (Galyean & Hales, 2022) to 127% (Axelsson 1949) with Ellis *et al.* (2007)2, Ellis *et al.* (2007)4, Ellis *et al.* (2007)1 and Kriss (1930) being intermediate at 95%, 101%, 115% and 122% respectively. Similarly, within stock types, emissions across equations relative to those of Yan *et al.* (2009) ranged from -13% (Galyean & Hales 2022) to +27% (Axelsson 1949) for steer yearlings, -8% (Ellis *et al.* 2007, 2) to +34% (Axelsson 1949) for heifer yearlings and -16% (Ellis *et al.* 2007, 2) to +18% (Kriss 1930) for suckler cows. The largest deviations within stock type were seen for heifer calves (+74%) and bull calves (+67%, both Ellis *et al.* 2007, 1) which may reflect differences in dietary composition and animal class compared to those in the baseline model (Yan *et al.* 2009).

**Table 1:** Direct methane emissions (kg/year) in GBSM and other prediction equations in a suckler beef system

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Stock type | Yan *et al.* (2009)\* | Ellis *et al.* (2007) 1 | Ellis *et al.* (2007) 2 | Ellis *et al.* (2007) 4  | Galyean & Hales (2022) | Kriss (1930) | Axelsson (1949) |
| Suckler cows | 3671 | 3753 | 3069 | 3378 | 3287 | 4340 | 4280 |
| Heifer calves | 535 | 930 | 794 | 779 | 487 | 729 | 766 |
| Bull calves | 604 | 1006 | 853 | 857 | 594 | 859 | 947 |
| Heifer yearlings | 1234 | 1393 | 1133 | 1205 | 1134 | 1516 | 1651 |
| Steer yearlings | 1342 | 1433 | 1176 | 1273 | 1166 | 1561 | 1711 |
| Total | 7386 | 8515 | 7025  | 7492 | 6668 | 9005 | 9355 |
| Total *vs.* \* % |  | 115 | 95 | 101 | 90 | 122 | 127 |
| Parameters | ME, GE, DELW, FP | MEI | DMI | DMI, FP | DMI | DMI | DMI |

ME = Metabolisable Energy (MJ); GE = Gross Energy (MJ); DE = Digestible Energy (MJ); LW = Liveweight (kg); FP = Forage Proportion; MEI = Metabolisable Energy Intake (MJ/day); DMI = Dry Matter Intake (kg/day).

**Conclusions:**Differences exist in direct methane emissions from enteric fermentation using either single (DMI) or multi-factor (DMI and FP) prediction equations in whole farm beef systems on high forage diets. Emissions (kg/year) are positively correlated to live weight (thus DMI capacity) and duration of animal stay on farm.

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