Methane phenotyping with different durations provides similar genetic parameters

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Introduction Genetic selection for low methane emitting (CH_4) sheep, can reduce greenhouse gas emissions (Rowe *et al*. 2019). Previously, Paganoni *et al*. (2017) and other Australian projects phenotyped sheep for CH_4, using portable accumulation chambers (PAC). The PAC methodology requires animals remain in an airtight chamber with methane measured at set time points, lowering throughput of animals and thus limiting the data collection needed for genetic evaluations. Methane traits for Australian sheep have been shown to be heritable (Paganoni *et al*. 2017; Wahinya *et al*. 2022). Recent projects aim to phenotype enough animals to provide the Australian sheep industry with reliable CH_4 breeding values. We compared different measurement durations, to determine if it is appropriate to reduce the measurement duration for genetic evaluation purposes.

Material and methods Historic (Paganoni *et al*. 2017) and recent (Fitzgerald *et al*. 2023) CH_4 datasets were analysed independently. The historic data measured ewes and rams at 20, 40, and 60min durations, measurements were repeated after one-month. The recent data measured ewes and lambs once for both short (20 and 25 min, respectively) and long (40 and 50min, respectively) durations. The historic analysis fitted a repeatability animal model for CH_4 rate (mL/min) with fixed effects: time of measurement, contemporary group (flock, year, sex, breed, measurement group, and management group), dam age, birth and rearing type, dam flock, run, pen, chamber, and live weight as a covariate. The recent data fitted an animal model for CH_4 rate with the historic fixed effects but with sire and dam breed added, and breed and sex (lambs) fitted separately.

Results Estimates of heritability ranged between 0.08 and 0.17, with relatively high standard errors (Table 1). The historic data tended to have higher heritabilities for the longer durations, this trend was not observed with the recent data. Repeatability for the historic data ranged between 0.14 and 0.32. From the recent data, high phenotypic (0.89 ± 0.01) and genetic (0.89 ± 0.07) correlations were estimated for the 20 and 40min durations.

Table 1. Summary statistics and parameter estimates for methane traits measured at different durations.

Methane rate (mL/min)	Animals	Records	Mean ± SD	Phenotypic variance ± SE	Heritability ± SE
Historic 20min ewes & rams	1,399	2,997	42.0 ± 18.9	224.8 ± 6.1	0.08 ± 0.03
Historic 40min ewe & rams	1,395	2,779	42.1 ± 16.3	171.3 ± 5.1	0.12 ± 0.04
Historic 60min ewe & rams	1,393	2,751	44.2 ± 18.3	213.6 ± 6.5	0.13 ± 0.04
Recent 20min ewes	987	987	10.2 ± 8.4	24.7 ± 1.3	0.17 ± 0.07
Recent 40min ewes	987	987	12.6 ± 8.9	24.0 ± 1.2	0.14 ± 0.07
Recent short 20&25min ewes & lambs	1,971	1,971	10.0 ± 6.9	22.4 ± 0.8	0.13 ± 0.05
Recent long 40&50min ewes & lambs	1,971	1,971	12.1 ± 7.2	20.8 ± 0.8	0.12 ± 0.05

Conclusion and implications Measurement durations are highly correlated and heritability estimates are similar between durations. Shorter durations would increase the number of animals phenotyped. Further analysis is needed for validation, and to determine the benefit of additional animals compared to loss of accuracy. At present, it is recommended to measure longer durations, as data cannot be added retrospectively.

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