Indirect selection for methane emission in Norwegian Red cows

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Introduction

Background

Methane emission from dairy cattle has gained significant attraction because of its contribution to climate change and loss of 2-12 % dietary energy from the animals[1]. In Norway, 60% of agricultural methane emissions comes from ruminants[2]. A research herd of Norwegian Red cows with two groups that since 1989 have been selected for high milk production (HL) and mastitis resistance (FL), respectively, had methane data available for research[3]. Differences in methane emission between the two genetic groups would be an indication of indirect selection responses after selection for milk yield or mastitis resistance.

Objectives

1. Compare methane emissions between two groups (HL and FL) of Norwegian Red cows.
2. Examine effects of genetic group, parity, lactation stage and calving season on methane emissions.

Material & Method

- Data from two groups of Norwegian Red cows, HL & FL, at the Center for Animal Experiments , NMBU
- 5,012 observations of methane production measured with Greenfeed system from 18 HL and 29 FL cows from February to May 2020.
- Data analysis using linear model in R, estimating the effects of genetic group (HL, FL), lactation number (1, 2, 3), lactation week (8 to 33), month-year of calving, and group by lactation number
- Least-squares means were calculated using 'gls' function from 'nlme' package in R

Results

- Average methane production in the herd was 441g/d.
- Significant effects of genetic group, lactation number, lactation week, month-year of calving and group by lactation number

Table 1. Least squares mean for methane emission (g/d) with standard errors for the two groups

Group	Least squares means	Standard Error
High milk production	444	4.67
Mastitis resistance	430	5.70

Table 2. Least squares mean (LS-mean) for methane emission(g/d) with standard errors for combination of groups High milk production (HL) and mastitis resistance (FL) with lactation *number 1, 2 and 3*

Group	Lactation number	Least squares means	Standard Error
High milk production	1	399	5.96
High milk production	2	500	6.52
High milk production	3	432	13.78
Mastitis resistance	1	400	5.75
Mastitis resistance	2	423	7.36
Mastitis resistance	3	468	7.14

Table 3. Least squares mean for *methane emission (g/d) with standard errors for lactation number 1, 2 and 3*

Lactation number	Least squares means	Standard Error
1	400	5.43
2	461	6.03
3	450	6.68

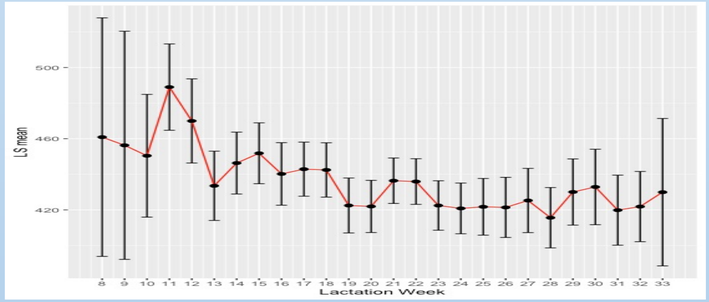

Figure 1. Lactation *curve for methane emission from week 8 to 33*

- The average daily methane emission was higher for HL than for FL, and the difference is statistically significant (Table 1)
- Daily methane emissions were lowest in 1st lactation both for HL and FL. The difference between all pairwise combinations of groups and lactation numbers were significant, except between HL and FL in lactation number 1. (Table 2)
- Methane emission was highest in lactation 2 and lowest in lactation 1.The difference between lactation 1 & 2, and 1 & 3 were significant (Table 3).
- The pairwise differences and overlapping of standard error bars showed non-significant differences between most lactation weeks (Figure 1).
- Methane production was higher for cows calving in autumn than in winter. Difference between autumn months and winter months was significant , but within-months difference was insignificant.

Conclusion

Genetic group, lactation number, lactation week and calving season affected methane production in Norwegian Red cows.

The significant difference in methane emission between the two genetic groups indicates that the selection for milk yield and/or mastitis resistance affects the daily methane emission.

References

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