Effect of either soya or linseed oil supplementation of grazing dairy cows on milk production and methane emissions

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Introduction Methane (CH_4) accounts for approximately 50% of total greenhouse gas (GHG) emissions (on a CO_2 equivalents basis) from the average Irish dairy farm and represents a loss of up to 8.5% of gross energy intake (GEI) in dairy cows (Tamminga *et al*., 2007). Dietary polyunsaturated fatty acid (PUFA) supplementation, especially linoleic (n-6) and linolenic acids (n-3) have been shown to reduce ruminal methanogensis (Martin *et al*., 2008, Petrie *et al.,* 2009) in indoor housed animals. The aim of this study was to assess the impact of oils rich in either n-3 or n-6 PUFA on milk production and CH_4 emissions of grazing dairy cows.

Materials and methods Forty five Holstein Friesian cows were blocked according to parity (24 multiparous and 21 primiparous) and allocated to one of three dietary treatments balanced for days in milk (mean 143 days, S.D. ± 22) and pre-experimental milk yield (mean 24.6 litres, S.D. ± 4.8) in a randomised block design. All treatments were allocated 17 kg grazed grass DM per day per cow, following morning milking plus 4 kg (DM) of concentrates containing 160g/kg (FW) of stearic acid (C), soya oil (SO) or linseed oil (LO), daily. Concentrates were offered in equal allocations at morning and afternoon milkings. Animals were introduced to their treatment diets over a 7-day period, following which they had an adjustment period of 17 days. Individual CH_4 emissions were measured using the SF_6 technique as described by Johnson *et al*. (1994), 17 (PI) and 44 (PII) days post diet introduction. Milk production was recorded daily and milk composition was assessed on a weekly basis. Statistical analysis was performed using the mixed procedure of SAS with terms included for treatment, period and their interaction.

Results Data for CH_4 emissions are shown in Table 1. Both treatment and period affected all CH_4 variables measured ($P<0.001$). There were treatment x period interactions for daily CH_4 ($P<0.001$), CH_4/kg milk ($P<0.01$) and CH_4/ kg milk solids ($P<0.001$). During PI both SO and LO reduced all CH_4 variables compared to the control, but during PII only LO reduced CH_4 variables compared to the control. Data for milk production across the entire experimental period are presented in Table 2. SO increased milk yield ($P<0.001$), milk protein % ($P<0.001$) and milk solids yield ($P<0.05$), and reduced milk fat % ($P<0.01$) when compared to C and increased milk yield compared to LO ($P<0.001$). LO increased milk protein % ($P<0.001$) compared to C but did not differ from C for any other milk production variable measured.

Table 1 Effect of supplementary lipid source on methane emissions of grazing dairy cows

	Period I				Period II				Significance		
	C	SO	LO	s.e.m	C	SO	LO	s.e.m	T	P	Tx P
Daily CH_4 (g)	260[a]	239[b]	221[c]	7.2	331[a]	348[a]	267[b]	7.1	***	***	***
gCH_4/kg milk	13.72[a]	11.99[b]	11.06[c]	0.4	18.38[a]	17.74[a]	13.93[b]	0.4	***	***	**
gCH_4/kg milk solids	181.3[a]	161.1[b]	152.2[b]	5.18	240.5[a]	229.4[a]	180.8[b]	5.18	***	***	***

[a, b, c] Means with different superscripts within rows are different ***P<0.001; **P<0.01

Table 2 Effect of supplementary lipid source on milk production and milk composition of grazing dairy cows

Treatment	Control	Soya oil	Linseed oil	s.e.d	Significance
Milk yield (l/d)	20.05[a]	21.52[b]	20.28[a]	0.120	***
Milk fat %	4.18[a]	3.84[b]	3.96[ab]	0.068	**
Milk protein %	3.35[a]	3.46[b]	3.42[b]	0.015	***
Milk solids yield (kg/d)	1.53[a]	1.59[b]	1.54[ab]	0.018	*

[a, b, c] Means with different superscripts within rows are different ***P<0.001; **P<0.01; *P<0.05

Conclusion Both SO and LO have the potential to reduce enteric CH_4 emissions from grazing dairy cows. However, the effects of LO appear to have a greater persistency over time. Furthermore, the addition of PUFA maintained or enhanced milk production variables compared to a saturated fat supplement.

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