Milk fatty acid profile and enteric methane production in dairy cattle fed grass- or grass silage-based diets

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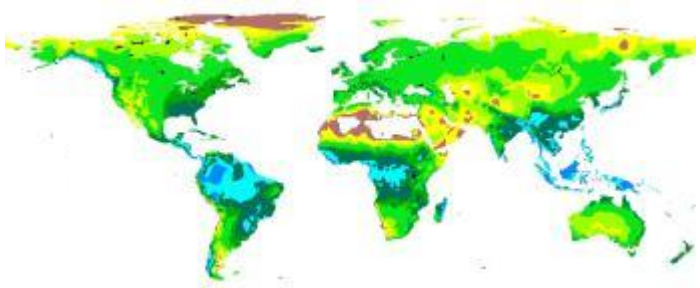
Milk fatty acid profile as proxy measure



- Grass is main feed base to produce milk
- Milk fatty acid (FA) profile proxy measure for enteric methane
  - lack of data on grass- or grass silage-based diets

Research objective

To quantify relationships between methane production and milk FA profile in dairy cattle fed grass- or grass silage-based diets

- methane measured in respiration chambers
- fatty acids analysed using gas chromatography

Experiments and data

Individual cow data (n=132), 3 experiments, 18 treatments

Experiment 1: grass herbage (85% diet DM) Warner et al. (2015)

- 2 fertilisation levels, 2 regrowth periods
- CH_4 treatment differences 9 to 14%

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- 2 fertilisation levels, 3 maturity stages
- CH_4 treatment differences 7 to 31%

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- 2 fertilisation levels, 3 maturity stages
- CH_4 treatment differences 7 to 31%

Experiment 3: grass silage (70% diet DM) unpublished

- 4 maturity stages, 2 lactation stages
- CH_4 treatment differences 4 to 29%

Animal characteristics

	Mean	SD	Min	Max
DMI (kg/d)	15.4	1.7	10.8	18.8
FPCM (kg/d)	24.8	5.4	12.3	39.4
CH_4 production (g/d)	341	41	234	444
CH_4 yield (g/kg DMI)	22.3	2.1	17.2	27.4
CH_4 intensity (g/kg FPCM)	14.2	2.9	8.5	24.8

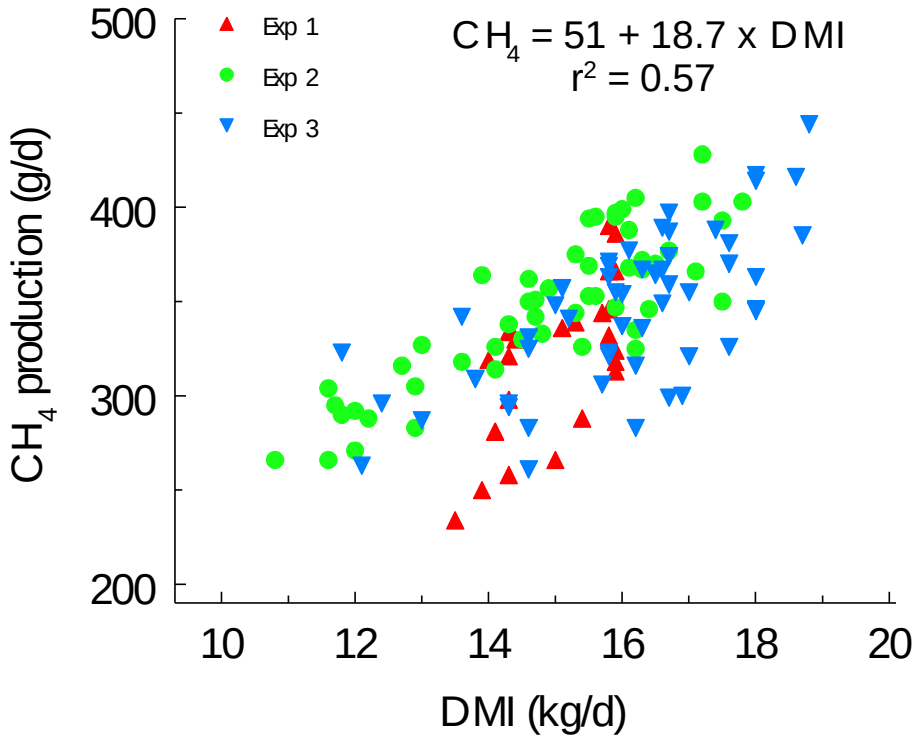
Calculations and statistical analyses

Mixed model regression technique

- relationship individual FA and CH_4
- discrete random experiment effect

CH_4 predicted with best multiple regression equations Van Lingen et al. (J Dairy Sci 2014)

Feed intake and methane production



CH_4 and straight short- and medium-chain fatty acids

Fatty acid	Chilliard (2009)	Moham-med (2011)	Dijkstra (2011)	Van Lingen (2014)	Rico (2016)	Present analysis *r*	
	g/d	g/d	g/kg DMI	g/kg DMI or FPCM	g/d	g/kg DMI	g/kg FPCM
C4:0							
C6:0							
C8:0							
C10:0							
C12:0							
C14:0							
C16:0							

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Fatty acid	Chilliard (2009)	Moham-med (2011)	Dijkstra (2011)	Van Lingen (2014)	Rico (2016)	Present analysis *r*	
	g/d	g/d	g/kg DMI	g/kg DMI or FPCM	g/d	g/kg DMI	g/kg FPCM
C4:0	+			–			
C6:0	+						
C8:0	+	+	+				
C10:0	+		+	+	+		
C12:0	+			+	+		
C14:0	+			+	+		
C16:0	+		+	+			

CH_4 and straight short- and medium-chain fatty acids

Fatty acid	Chilliard (2009)	Moham-med (2011)	Dijkstra (2011)	Van Lingen (2014)	Rico (2016)	Present analysis *r*	
	g/d	g/d	g/kg DMI	g/kg DMI or FPCM	g/d	g/kg DMI	g/kg FPCM
C4:0	+			–		-0.25	-0.32
C6:0	+						
C8:0	+	+	+				
C10:0	+		+	+	+		0.23
C12:0	+			+	+		0.34
C14:0	+			+	+		0.45
C16:0	+		+	+		0.36	0.53

CH_4 and odd- and branched-chain fatty acids

Fatty acid	Chilliard (2009)	Moham-med (2011)	Dijkstra (2011)	Van Lingen (2014)	Rico (2016)	Present analysis *r*	
	g/d	g/d	g/kg DMI	g/kg DMI or FPCM	g/d	g/kg DMI	g/kg FPCM
C14:0*iso*			+				
C15:0	+			+	–		
C15:0*iso*			+				
C15:0*anteiso*							
C16:0*iso*							
C17:0	+	–			–		
C17:0*iso*			–		–		

CH_4 and odd- and branched-chain fatty acids

Fatty acid	Chilliard (2009)	Moham-med (2011)	Dijkstra (2011)	Van Lingen (2014)	Rico (2016)	Present analysis *r*	
	g/d	g/d	g/kg DMI	g/kg DMI or FPCM	g/d	g/kg DMI	g/kg FPCM
C14:0*iso*			+			0.19	0.67
C15:0	+			+	–	0.33	0.75
C15:0*iso*			+			0.23	0.83
C15:0*anteiso*							0.70
C16:0*iso*							0.34
C17:0	+	–			–	0.30	0.31
C17:0*iso*			–		–		

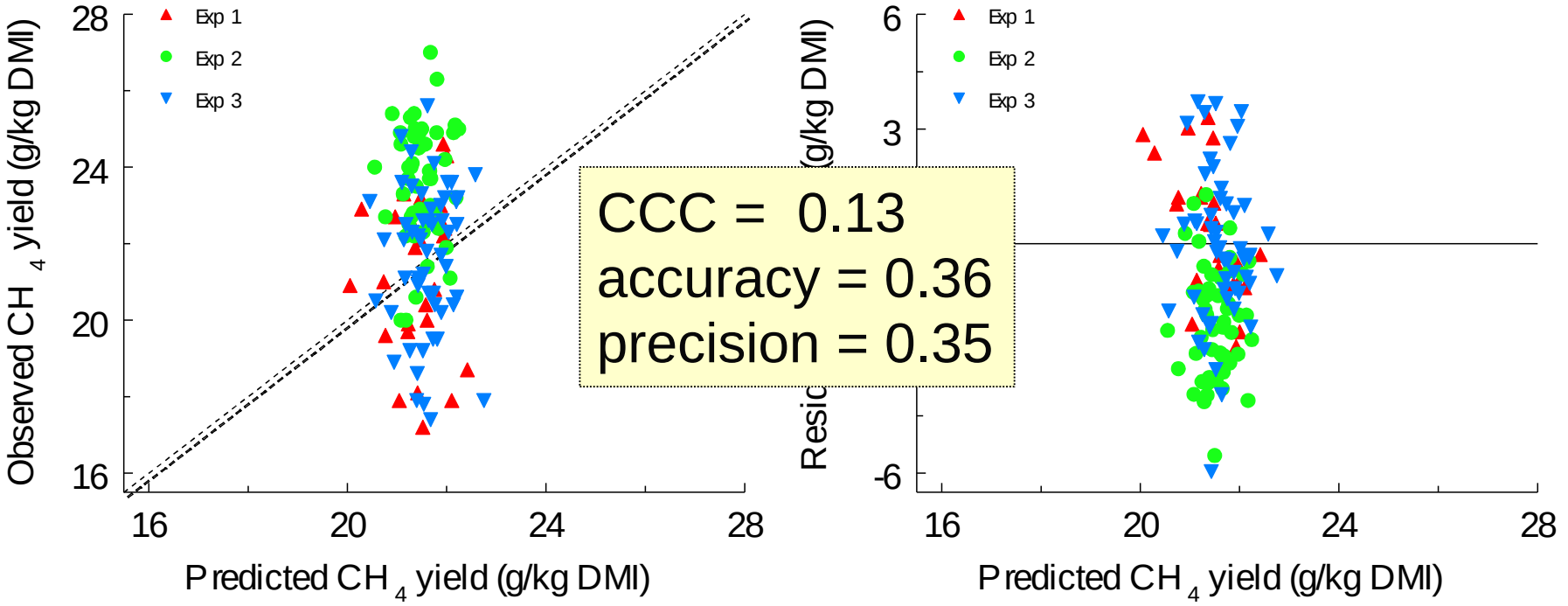
CH_4 and C18 fatty acids

Fatty acid	Chilliard (2009)	Moham-med (2011)	Dijkstra (2011)	Van Lingen (2014)	Rico (2016)	Present analysis *r*	
	g/d	g/d	g/kg DMI	g/kg DMI or FPCM	g/d	g/kg DMI	g/kg FPCM
C18:0				–			
C18:1*t*10	–	–	} –	} –	–		
C18:1*t*11							
C18:1*c*9	–		–	–			
C18:1*c*11		–	–	–	–		
C18:2n-6		–		–			
C18:3n-3		–			–		

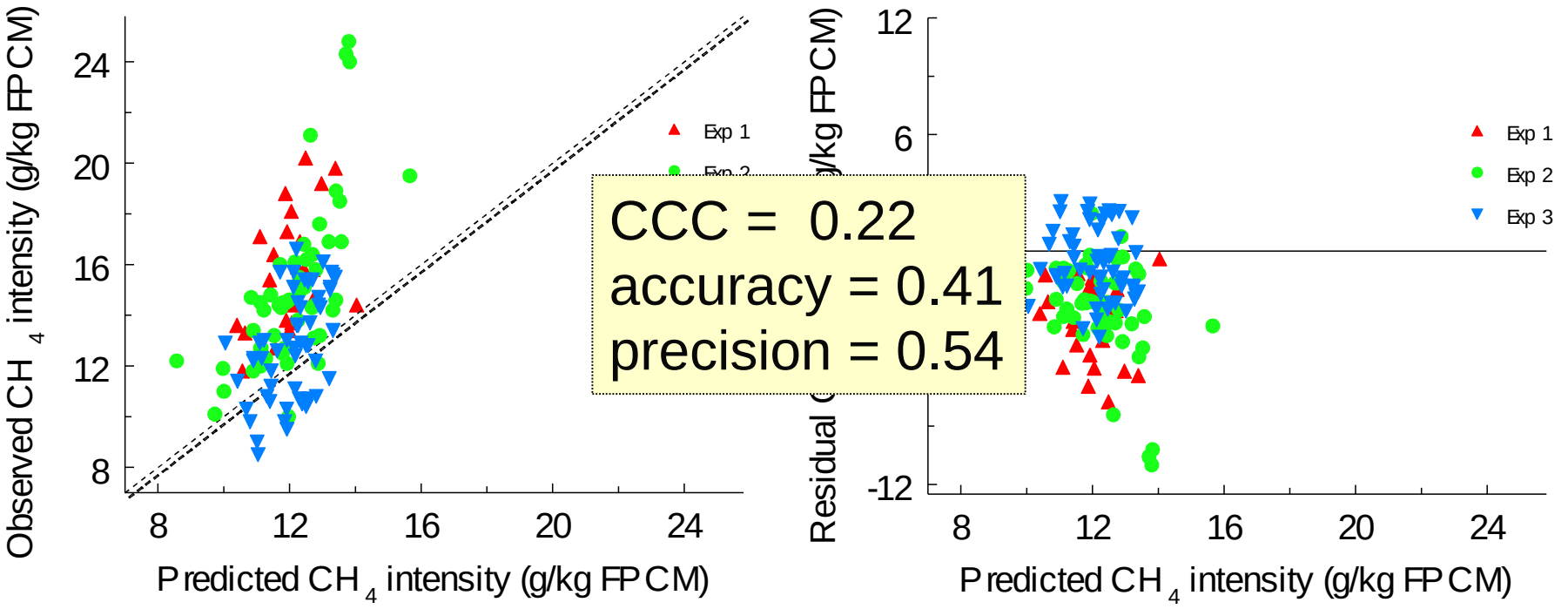
CH_4 and C18 fatty acids

Fatty acid	Chilliard (2009)	Moham-med (2011)	Dijkstra (2011)	Van Lingen (2014)	Rico (2016)	Present analysis *r*	
	g/d	g/d	g/kg DMI	g/kg DMI or FPCM	g/d	g/kg DMI	g/kg FPCM
C18:0				–			-0.23
C18:1*t*10	–	–	} –	} –	–	-0.30	
C18:1*t*11							
C18:1*c*9	–		–	–			-0.54
C18:1*c*11		–	–	–	–	-0.31	-0.54
C18:2n-6		–		–		-0.40	-0.25
C18:3n-3		–			–	-0.52	-0.32

Predicted CH_4 yield (eqn Van Lingen et al. 2014)



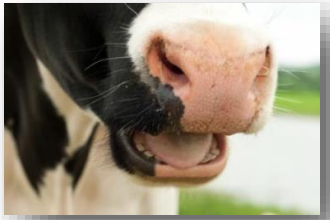
Predicted CH_4 intensity (eqn Van Lingen et al. 2014)



Conclusions

- Moderate to strong relationships between milk FA and CH_4 yield or intensity in dairy cattle fed grass- or grass silage-based diets
- Relationships largely differed from those for other types of diets
- Milk FA profile as proxy measure for enteric CH_4 may require diet-specific prediction equations

Acknowledgements



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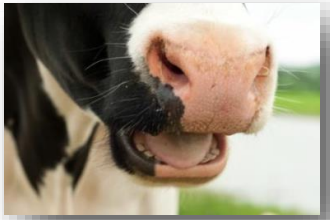

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Van Lingen (2014) equations

CH_4 yield (g/kg DM) = 23.4

+ 9.74 × C16:0*iso*	(*r* = 0.07)
- 1.06 × C18:1*t*10+11	(*r* = -0.19)
- 1.75 × C18:2n-6	(*r* = -0.40)

CH_4 intensity (g/kg FPCM) = 21.1

- 1.38 × C4:0	(*r* = -0.32)
+ 8.53 × C16:0*iso*	(*r* = 0.34)
- 0.22 × C18:1*c*9	(*r* = -0.54)
- 0.59 × C18:1*t*10+11	(*r* = 0.03)