

Fatty acid concentrations in forages

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Crude fat and fatty acids in forage and TMR

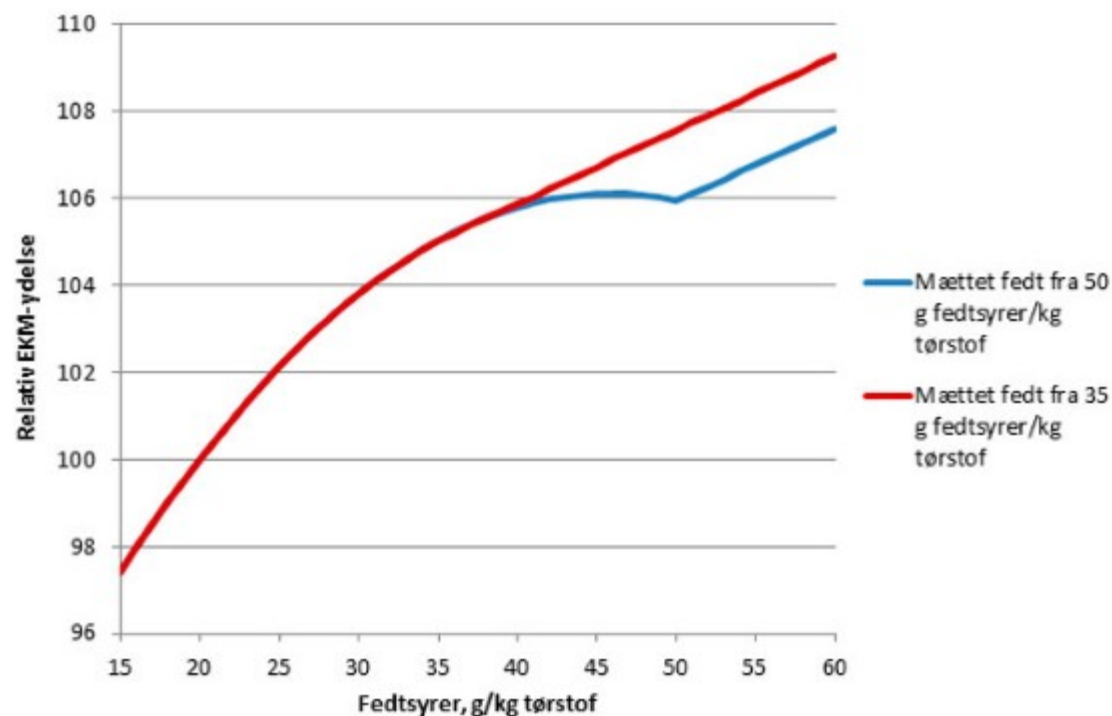
- a collaborative project between AU and SEGES

The project objective is to create a new improved analytical basis for optimizing fat in cattle feed rations

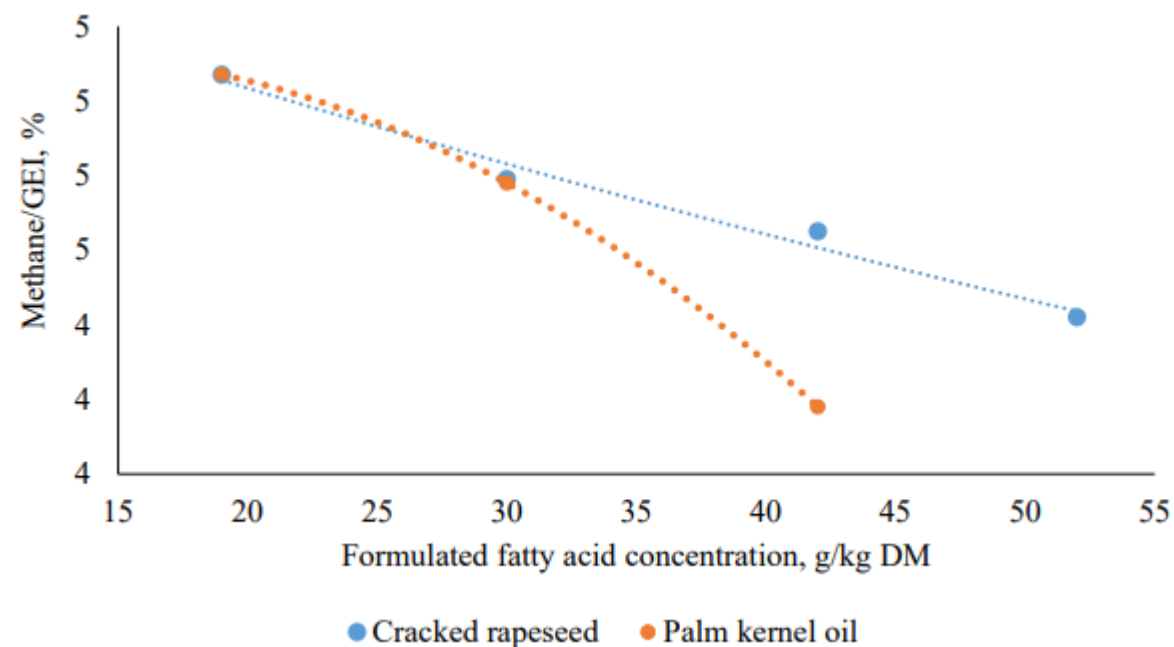
Main tasks:

- Investigation of methods for determining crude fat and fatty acids in forage (AU)
- Investigation of chemical fractions in crude fat that are not fatty acids (AU)
- Development and validation of NIR for prediction of crude fat and fatty acids in forage and TMR (SEGES)

Increasing fatty acid concentration in the ration increases ECM yield and reduces methane emission



Thøgersen, 2015. Beregn økonomien i at fodre med fedt. LandbrugsInfo, SEGES Innovation.



Kjeldsen, M.H., Jensen, M.B. & Lund, P. 2022. Potent methane reducing feed additives in a Danish context, and their reduction potential, additive effects, risks related to animal welfare and carry-over to milk, and potential trade-offs. Advisory report from DCA – Danish Centre for Food and Agriculture, 88 pp.

The official EU method probably underestimates the concentration of fatty acids in forage

- Forage has low concentrations of fatty acids and a large proportion is bound in more polar compounds compared to concentrates.
- This poses some risks:
 - Short-chain fatty acids and phospholipids will be washed through the filter during the filtration process and escape the analysis
 - Oxidation of polyunsaturated fatty acids can occur during the drying process
 - Polar fats are not extracted with the relatively apolar solvents like petrol ether or diethyl ether, but require a more polar solvent like chloroform (Jensen, 2008)

Examples on difference in fatty acid concentration between methods for different matrices

Methods	Pretreatment	Extraction	Concentrates ¹⁾ Relative	Pig feces ²⁾ Relative
Diethyl ether	No pretreatment	Diethyl ether	79	
Stoldt fat	Boiling with HCl	Diethyl ether	100	100
EC No. 152/2009	Boiling with HCl	Petrol ether	96	
Chloroform-HCl-chloroform	Chloroform-HCl	Chloroform	98	
HCl-Bligh & Dyer	Boiling with HCl	Methanol-chloroform		118

1) Andersen, 1991. Fedtekstraktion. 786. Meddelelse fra Statens Husdyrbrugsforsøg

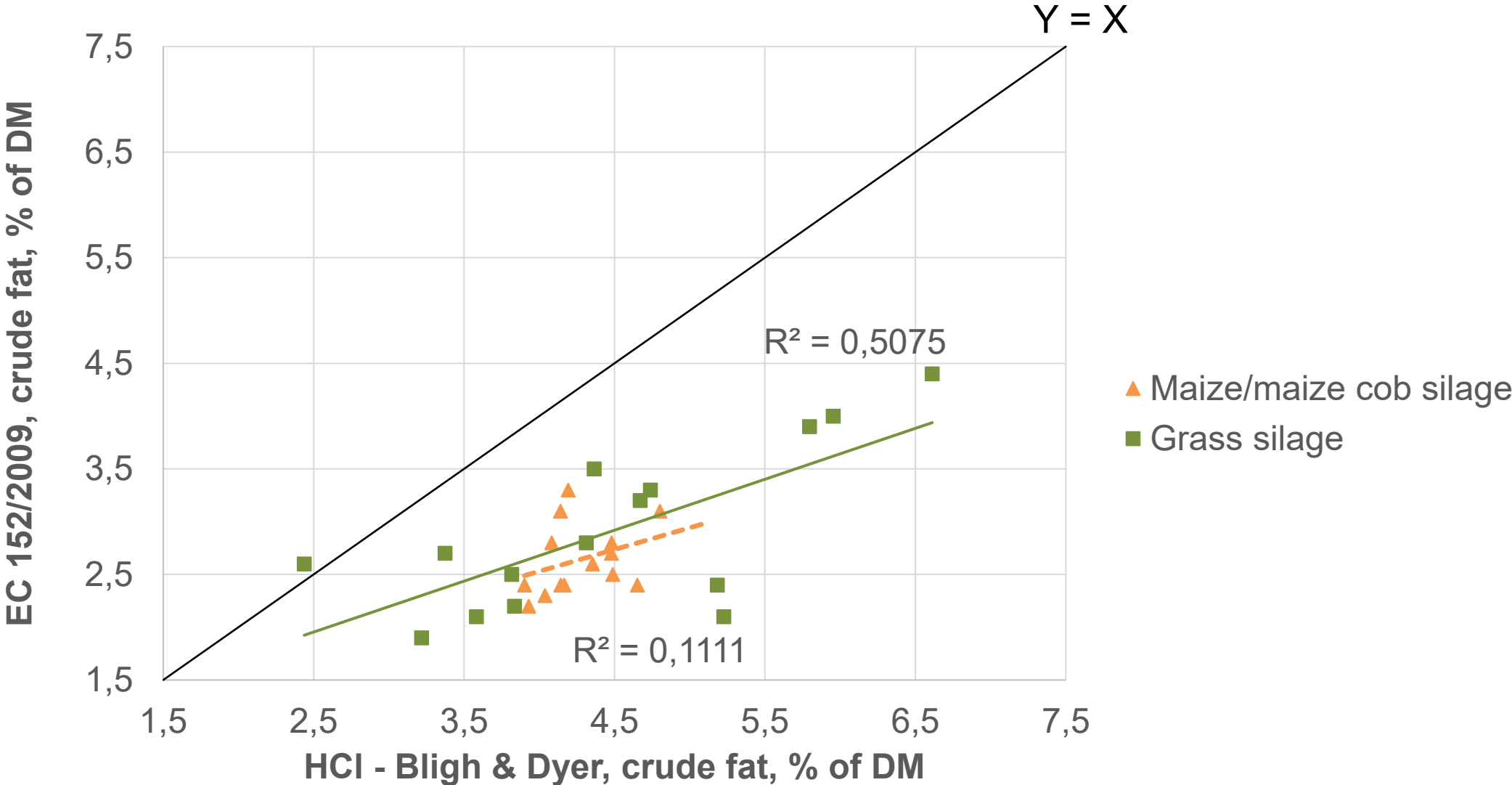
2) Jensen, S.K., 2008. Improved Bligh and Dyer extraction procedure. Lipid Technology, Vol. 20, No. 12.

Status of samples for NIR calibration

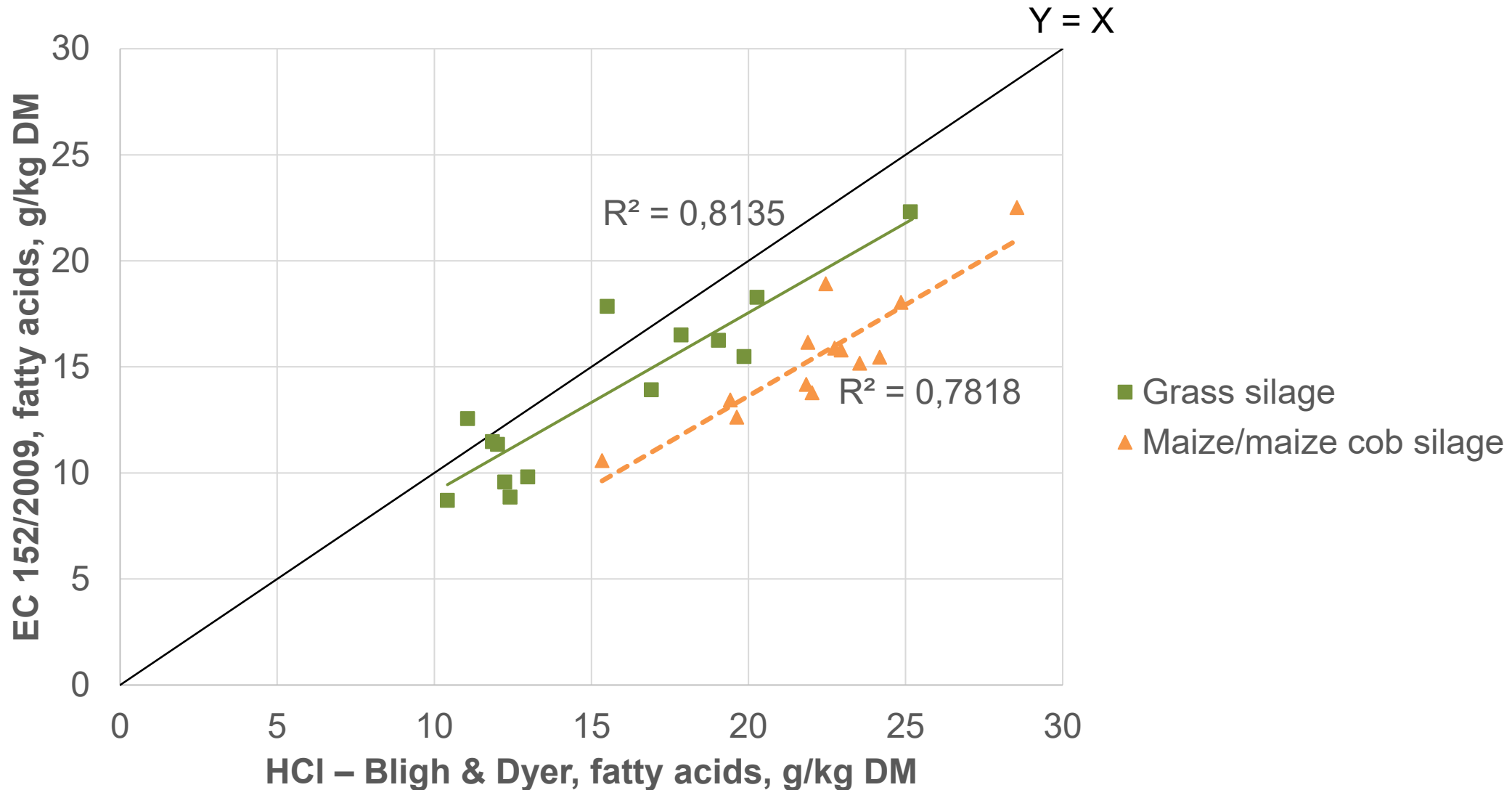
- 15 samples of respectively grass and maize silage analyzed at AU by HCl-Bligh & Dyer and two commercial laboratories by the EU method
- Samples selected and analyzed for NIR-calibration:

	Pilot study	Analyzed	Under analysis	Total	Next step
Maize	15	68		83	?
Grass	15		72	87	?
TMR/PMR			57	57	?

Big difference in crude fat between methods



High correlation in total fatty acids between methods for grass and maize/maize cob silage, but big difference in level for maize



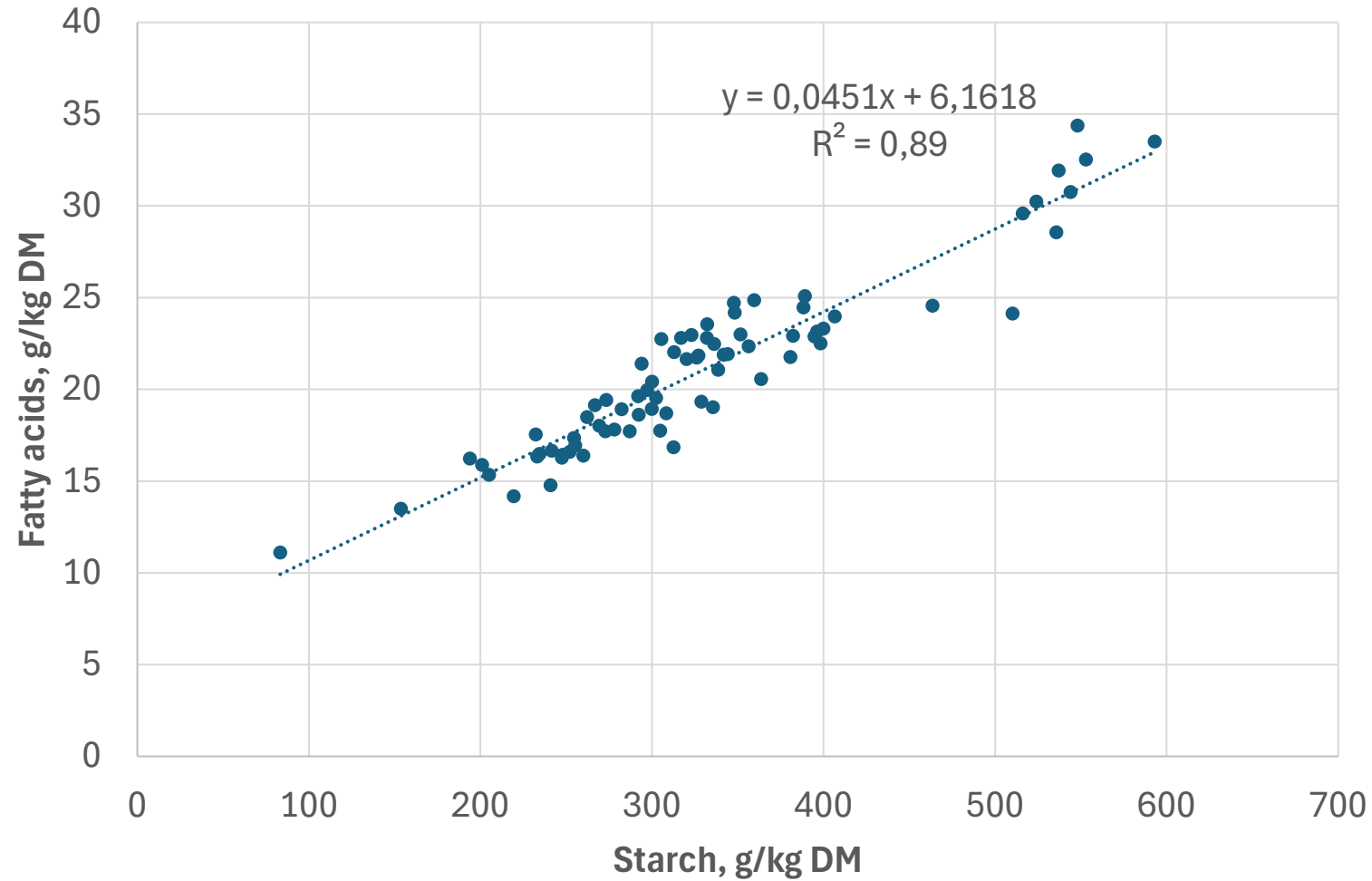
Results on crude fat and fatty acids based on the HCl-Bligh & Dyer method compared to NorFor table values

	Unit	Maize silage		Maize cob silage	
		NorFor	Project	NorFor	Project
Number of samples			66		10
Crude fat	g/kg DM	22	44	39	43
Fatty acid proportion	g/kg CFat	650	456	650	698
Fatty acids	g/kg DM	14,3	19,8	25,4	30,0

No significant changes on single fatty acids based on the HCl-Bligh & Dyer method compared to NorFor table values

	Units	Maize silage		Maize cob silage	
		NorFor	Project	NorFor	Project
Number of samples			66		10
Fatty acids					
Palmitic acid	g/100 g FA	16,5	17,8	13,0	15,2
Stearic acid	g/100 g FA	2,2	2,2	2,0	1,9
Oleic acid	g/100 g FA	22,7	18,3	24,0	21,3
Linoleic acid	g/100 g FA	50,0	49,3	57,0	56,8
Linolenic acid	g/100 g FA	5,4	7,7	2,0	1,8
Iodine value	g/100 g FA	125	128	129	128

High correlation between fatty acid and starch concentration in maize/maize cob silage



Changes in fatty acid contraction in feed rations for milking Holstein cows

Feedstuffs	DMI Kg DM	Crude fat, g/kg DM		Fatty acids, g/kg DM		
		NorFor table values	Eurofins 2025 EC 152/2009	NorFor table values	Eurofins NIR EC 152/2009	Project samples HCl-Bligh & Dyer
Maize silage	7,8	22	30	14,3	19,5	19,8
Maize cob silage	0,2	39	35	25,4	22,8	30,0
Cl. grass silage	6,3	44	34	17,2	13,3	(16,2)
Concentrates	10,8			53,5	53,5	53,5
Total	25,1			32,0	32,4	33,5

Questions for discussion

- Is NorFor going to change recommendation for analysis of crude fat and fatty acids in forage?
- Are the authorities going to accept the higher fatty acid concentration in forage (maize silage) for methane reduction?

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