Effect of rapeseed fat and saturated fat on milk production and enteric methane, when added to diets with different ratios between grass-clover and maize silage

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BACKGROUND

Dietary fat can reduce enteric methane (CH_4) from ruminants

- On average ~ 4 % reduction per 10 g increase in fatty acids per kg DM (Niu et al. 2018, Børsting et al., 2020)

Because (Hellwing et al., 2013)

- Fat is not fermented in the rumen (~1 % reduction)
- H_2 is used during biohydrogenation of unsaturated fat, and therefore does not form methane (~ 0.7 % reduction for rapeseed fat)
- Alters microbial fermentation of fiber (~ 2 % reduction depending on fat source)

To reduce enteric methane from 2025 it is mandatory in Denmark to

- To feed 60 mg 3-NOP (Bovaer) per kg DM during 3 month per year for non-organic dairy cows
- Or feed at least 48 g fatty acids per kg DM to non-organic dairy cows year round
  - This is 15 g more than in present average dairy diets in Denmark
  - Counts for a 6 % reduction of enteric methane in the farm account

AIM

To assess the impact of supplementing rape seed fat or saturated fat to diets with different grass-clover silage:maize silage ratios on

- Enteric methane yield (methane emission per kg DMI)
- Milk production
- Milk composition
- Rumen parameters
- To explore potential interactions between silage type and fat source.

EXPERIMENTAL SETUP

Lation square

- 4 treatments
- 4 fistulated cows
- 4 periods of 3 weeks

Methane measured during 96 hours of each period in respiration chambers

8 rumen samples per cow covering every 3rd hour of the day

FEEDSTUFF COMPOSITION OF DIETS (% OF DM)

SILAGE 59 % OF DM IN ALL DIETS 80% OF SILAGE FROM	GRASS	GRASS	MAIZE	MAIZE
Fat source	SATURATED	RAPE	SATURATED	RAPE
Saturated (45% of both C16:0 and C18:0)	2.8			
Rapeseeds, cracked	0			
Rapeseed cake	0			
Rapeseed meal	14.5			
Grass-clover silage	47.1			
Maize silage	11.8			
Urea mix (with 20% limestone)	0			
Wheat, rolled	21.2			
Maize gluten	1.2			
Sodium bicarbonate	0.4			
Other ingredients	2.2			

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Fat source	SATURATED	RAPE	SATURATED	RAPE
Saturated (45% of both C16:0 and C18:0)	2.8	0		
Rapeseeds, cracked	0	3.7		
Rapeseed cake	0	13.7		
Rapeseed meal	14.5	0		
Grass-clover silage	47.1	47.1		
Maize silage	11.8	11.8		
Urea mix (with 20% limestone)	0	0		
Wheat, rolled	21.2	21.2		
Maize gluten	1.2	1.2		
Sodium bicarbonate	0.4	0.4		
Other ingredients	2.2	2.2		

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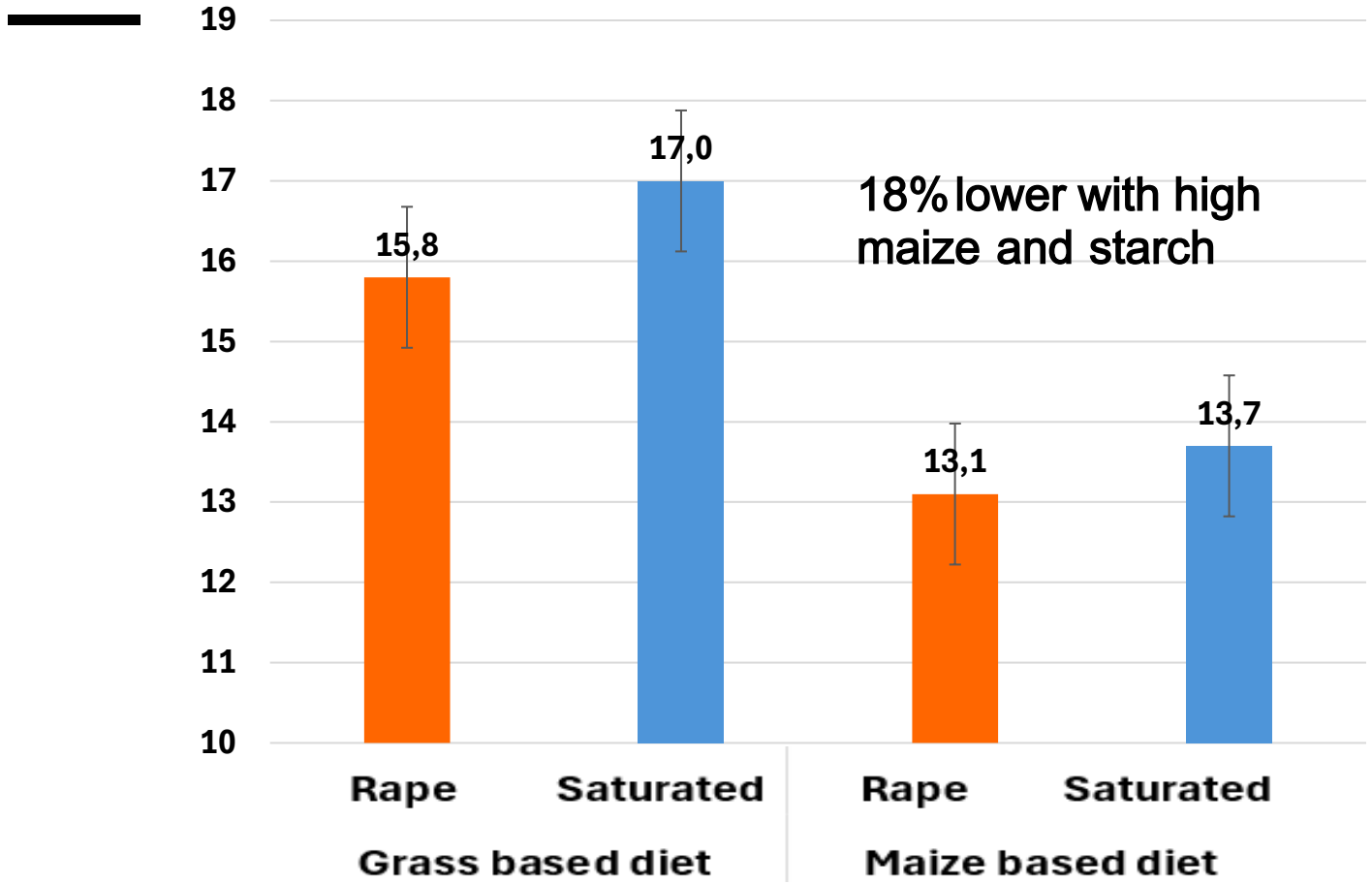
Saturated (45% of both C16:0 and C18:0)	2.8	0	3.1	0
Rapeseeds, cracked	0	3.7	0	3.9
Rapeseed cake	0	13.7	0	17.2
Rapeseed meal	14.5	0	18.1	0
Grass-clover silage	47.1	47.1	11.8	11.8
Maize silage	11.8	11.8	47.1	47.1
Urea mix (with 20% limestone)	0	0	0.9	1.1
Wheat, rolled	21.2	21.2	15.7	15.7
Maize gluten	1.2	1.2	1.2	1.2
Sodium bicarbonate	0.4	0.4	1.0	1.0
Other ingredients	2.2	2.2	2.4	2.4

CHEMICAL COMPOSITION OF DIETS (g/kg DM)

MAJOR SILAGE (80% OF SILAGE)	GRASS	GRASS	MAIZE	MAIZE
Fat source	SATURATED	RAPE	SATURATED	RAPE
Fatty acids	51	51	51	51
Crude fat	65	69	61	65
Iodine product*	38	68	38	62
Crude protein	177	173	171	169
Starch	185	185	255	255
NDF	270	275	263	273

* Iodine product per kg DM = gram crude fat per kg DM * iodine value/100

CH_4 YIELD(g/kg dry matter intake)

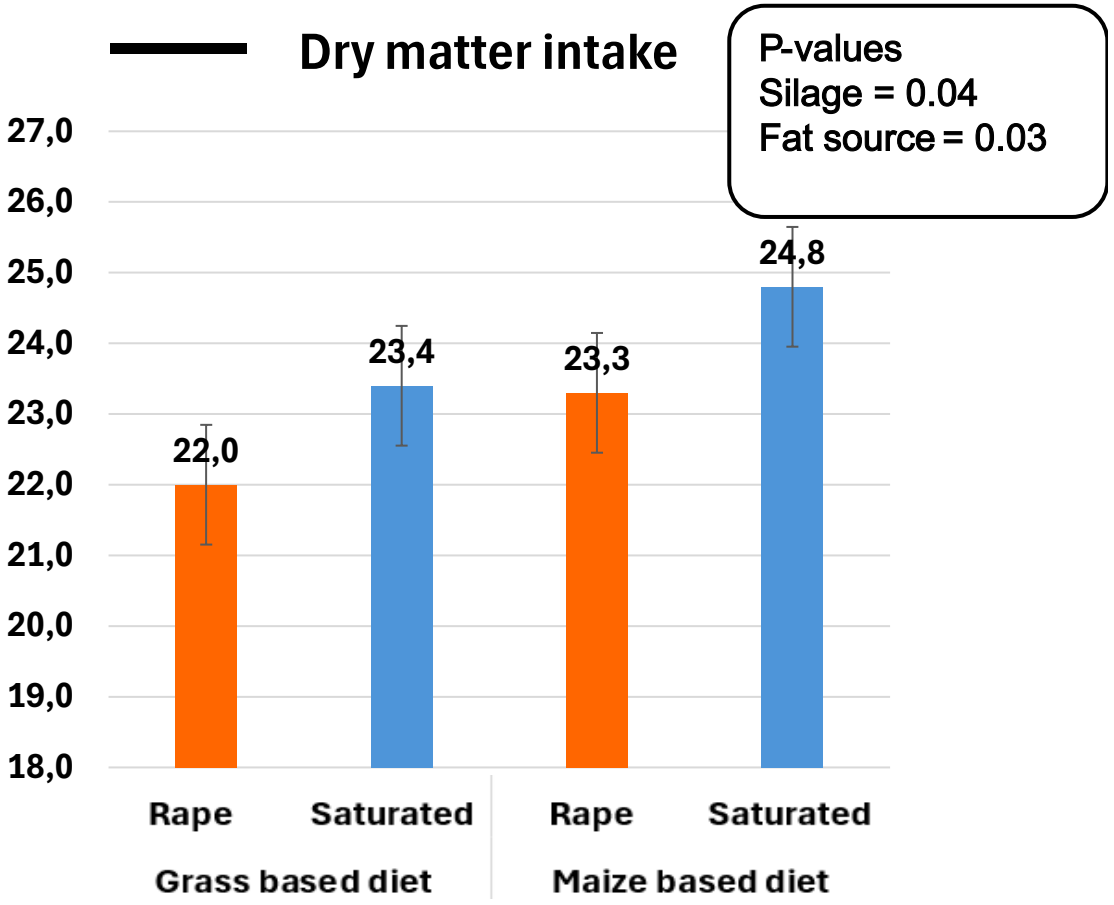


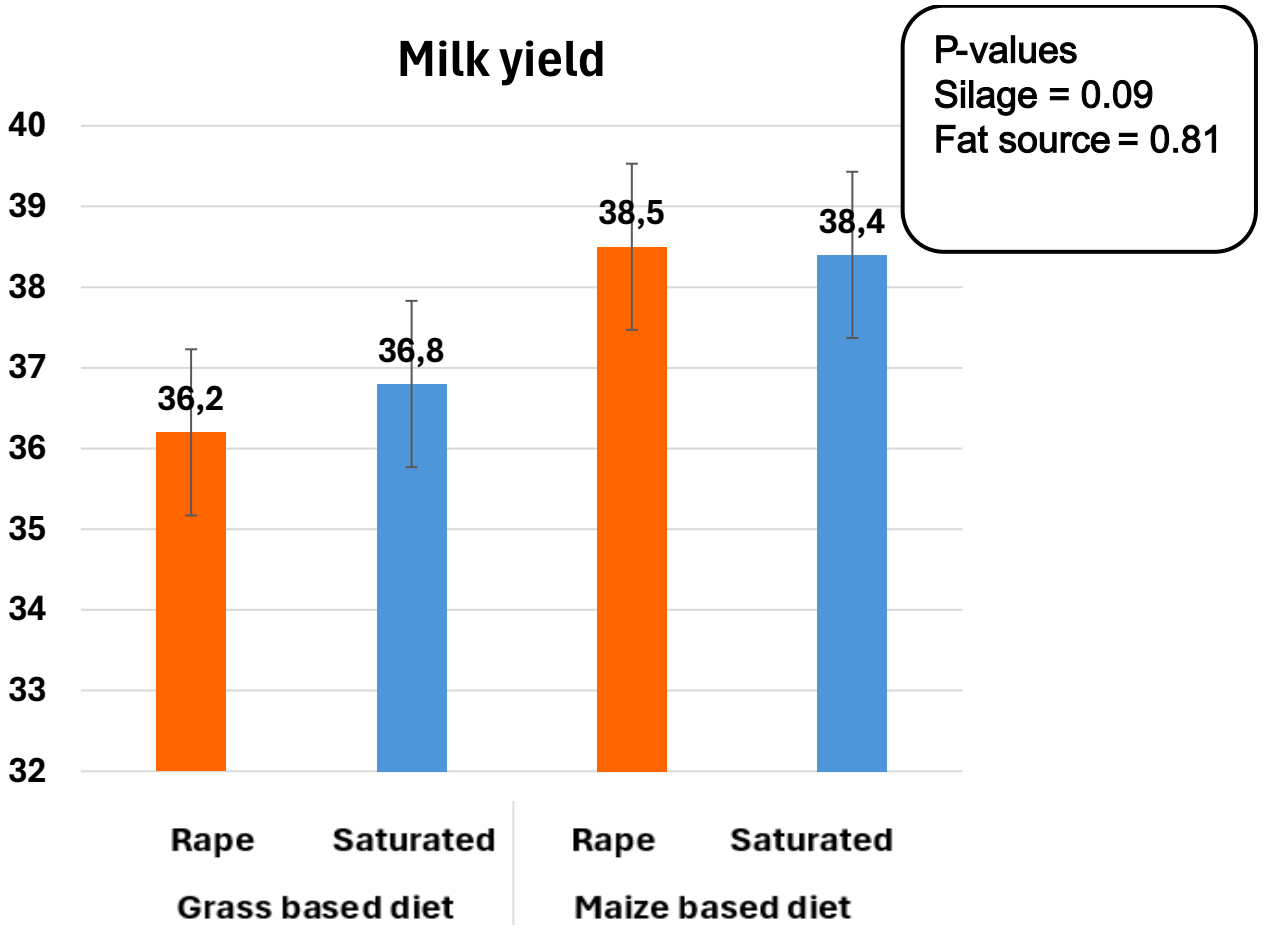
18% lower with high maize and starch

P-values
Silage = 0.001
Fat source = 0.14

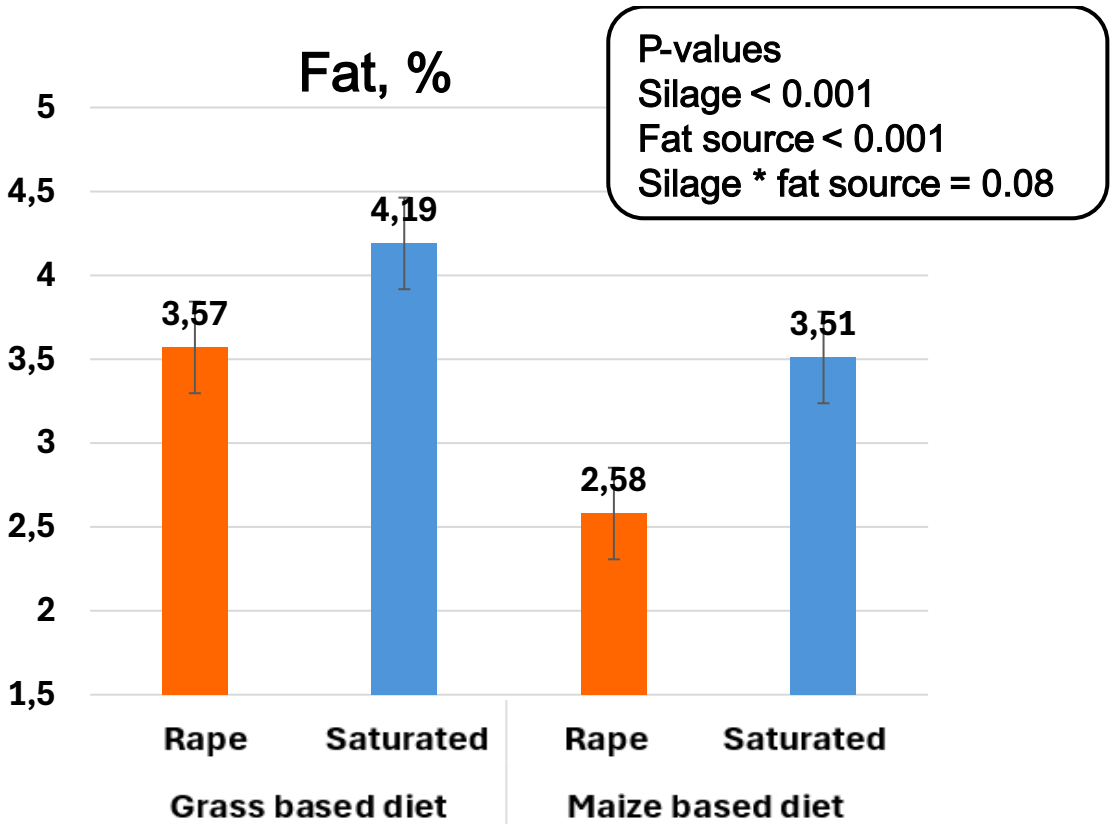
No significant effect of fat source

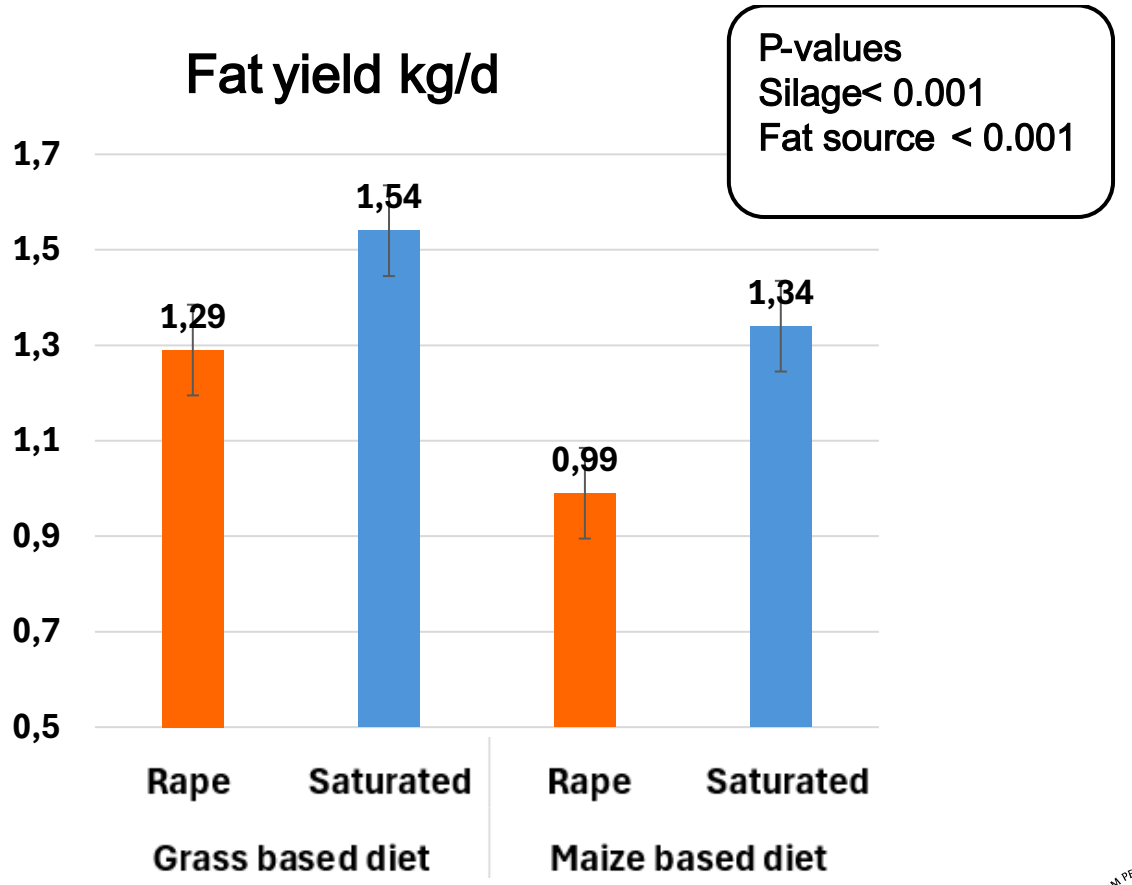
DRY MATTER INTAKE AND MILK YIELD (kg/ day)



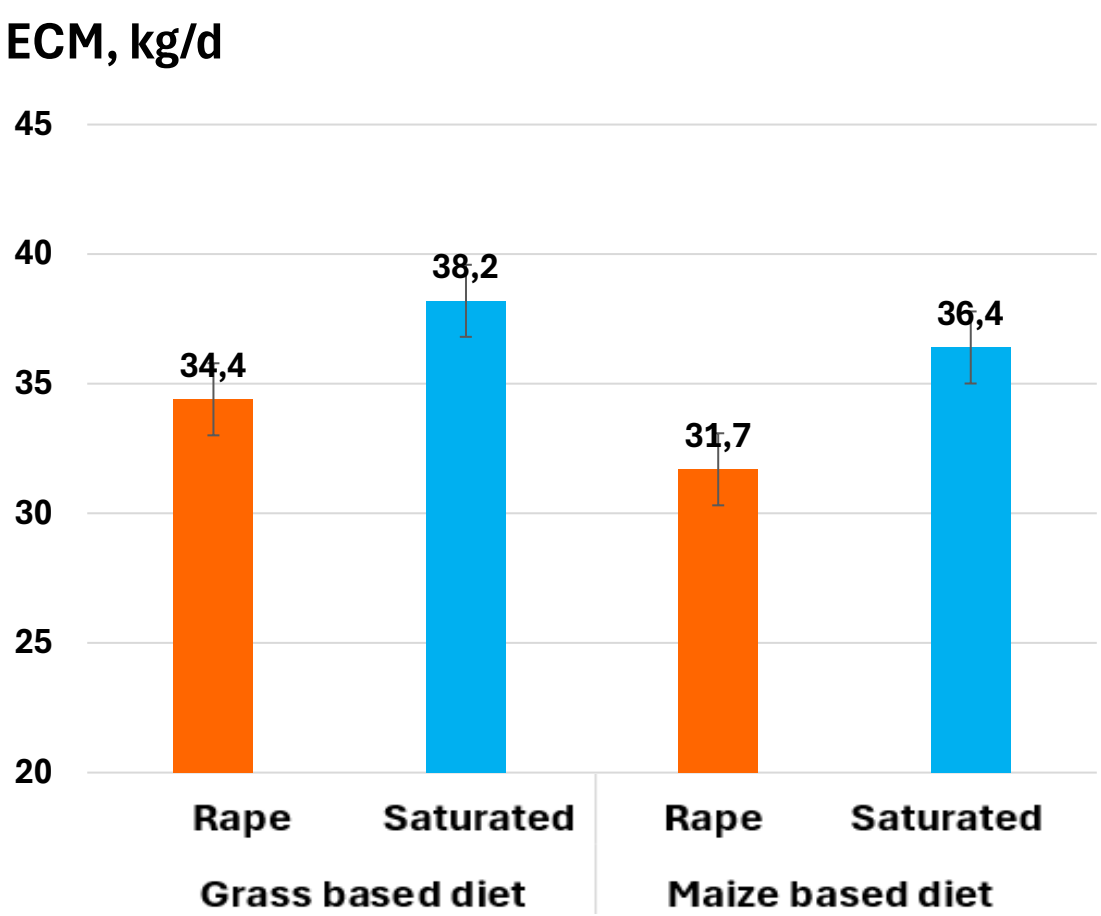


MILK FAT % AND MILKFATYIELD(kg/ day)



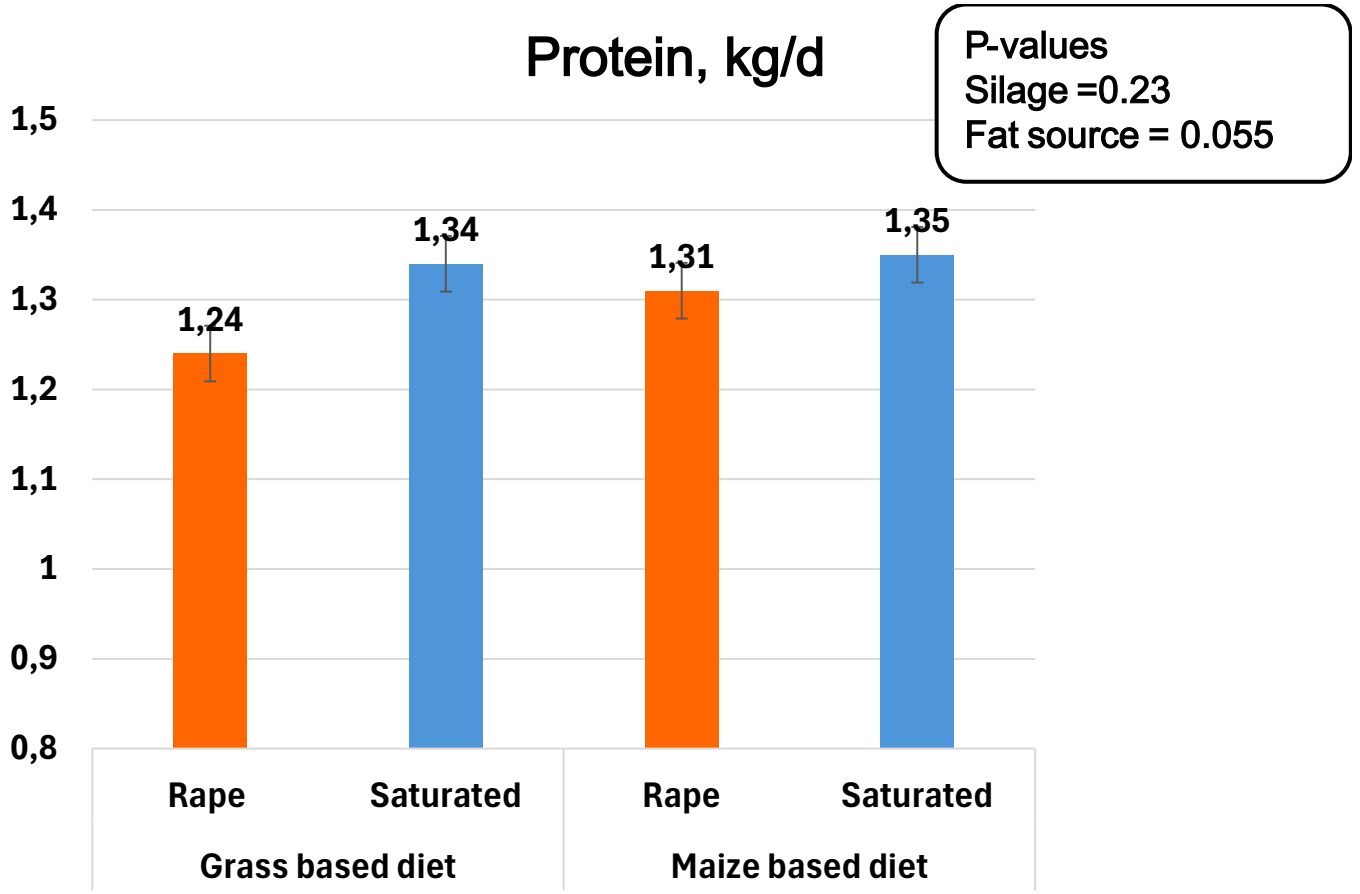


ECMYIELD(kg/d)

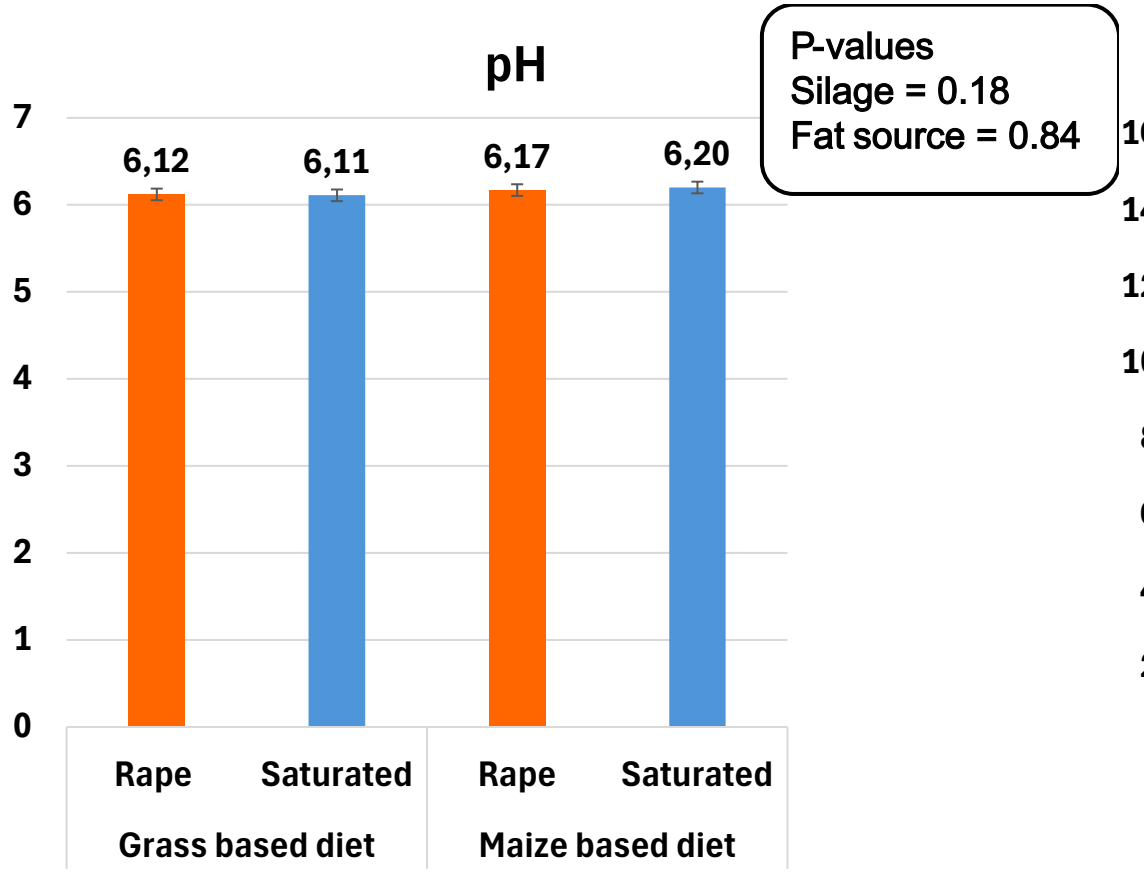


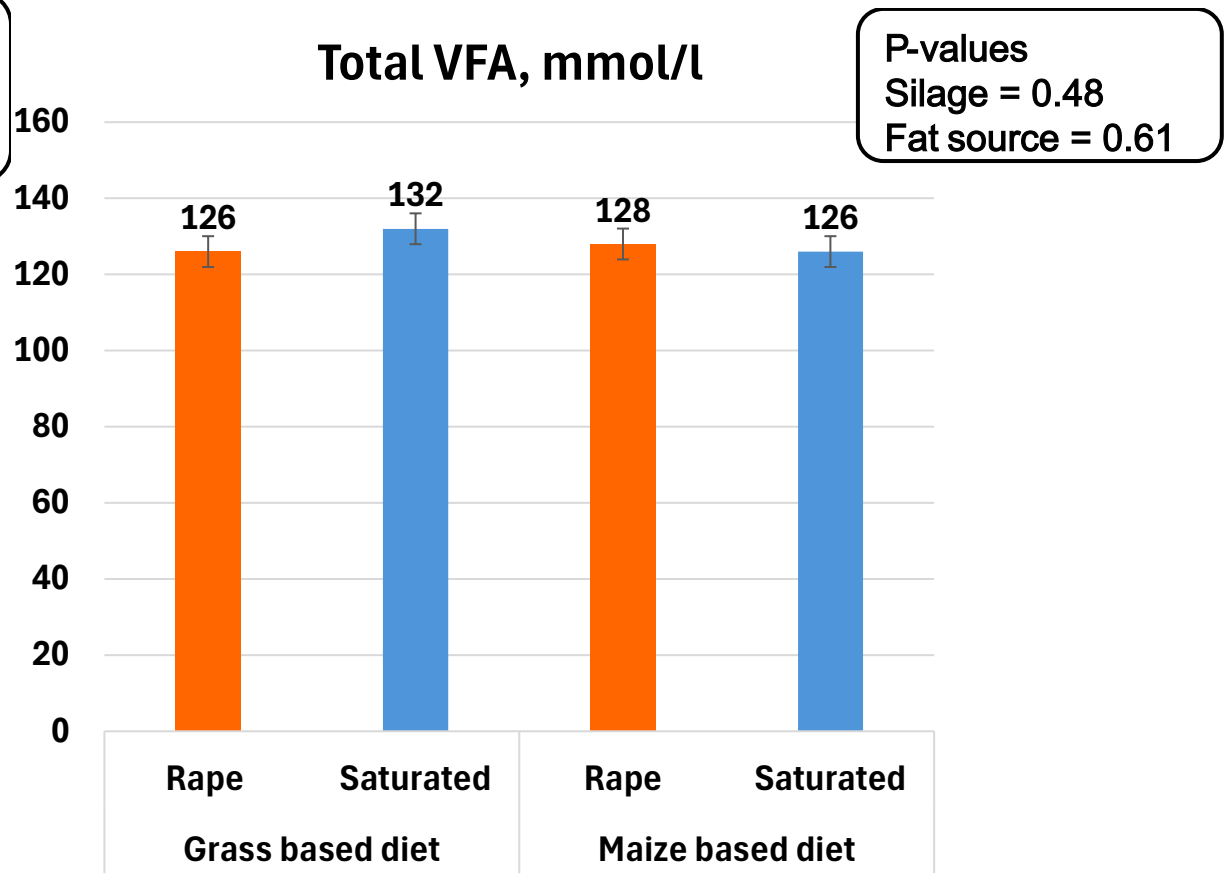
P-values
Silage = 0.02
Fat source < 0.01

MILK PROTEIN YIELD(kg/ day)

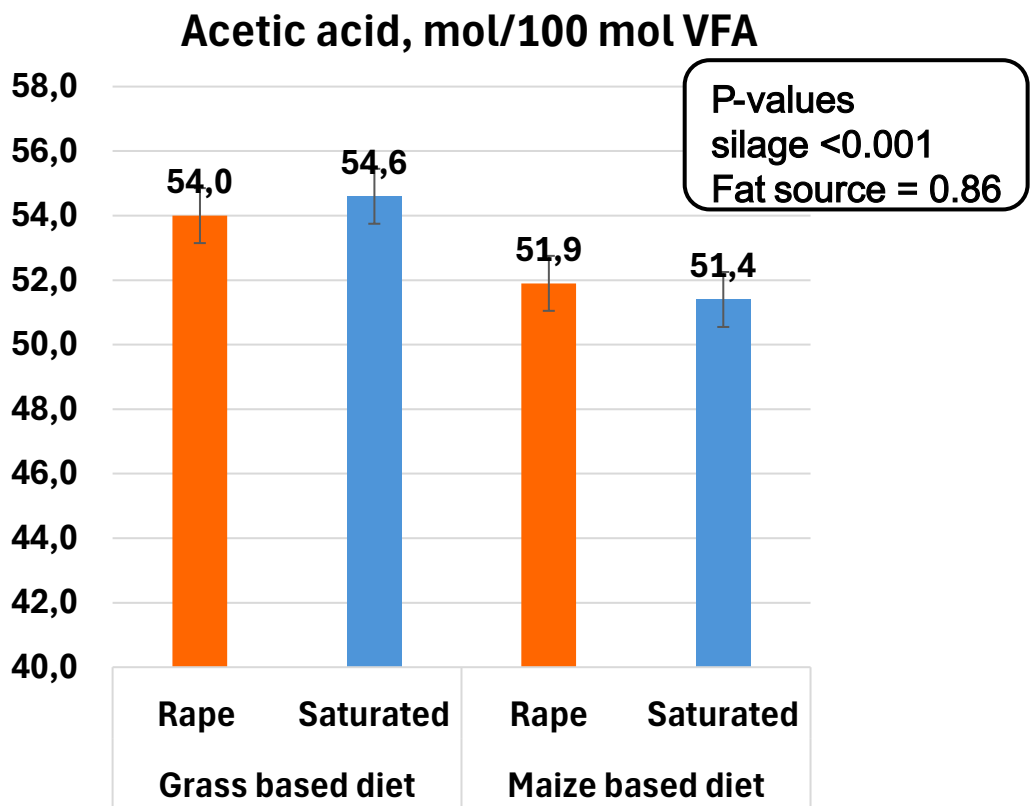


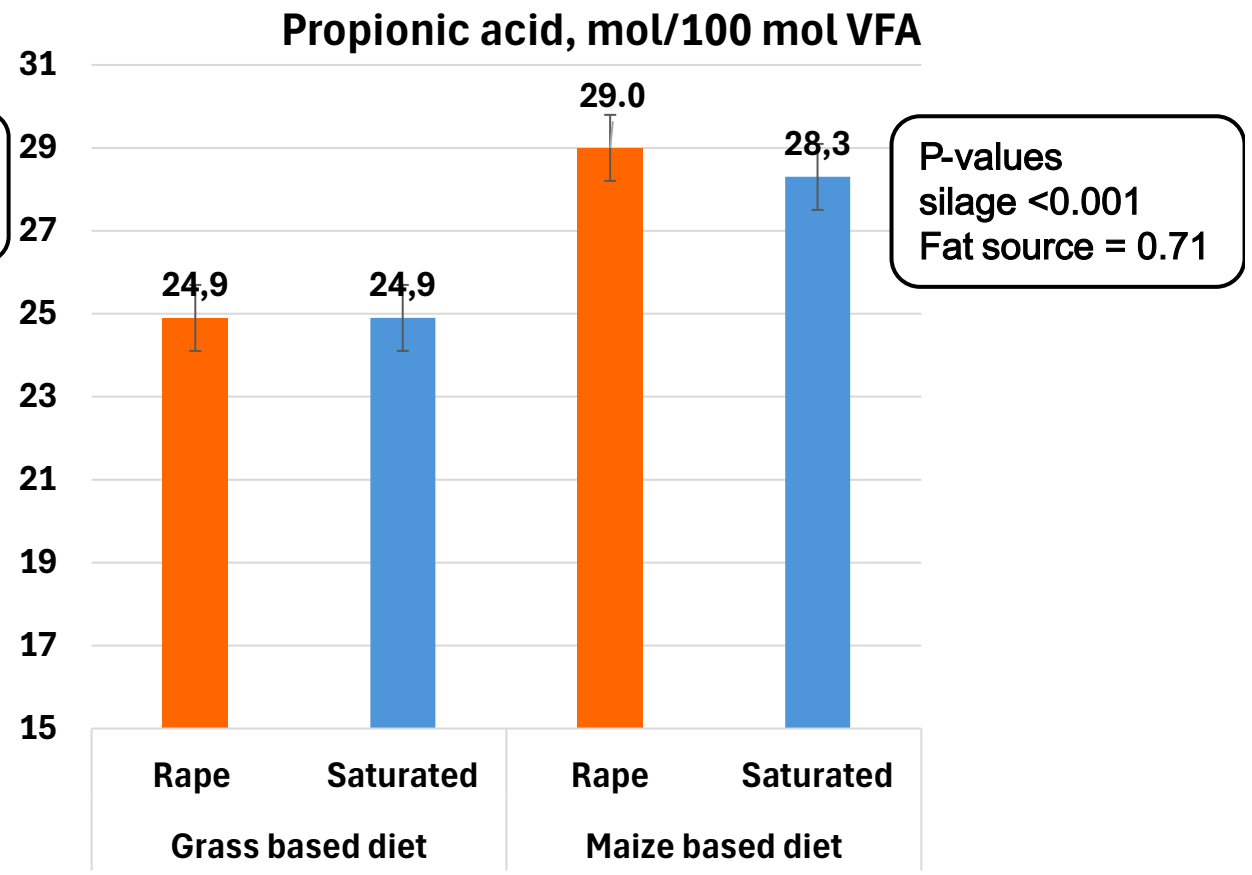
pH AND TOTAL VFA (mmol/l)





PROPORTIONS OF ACETIC ACID AND PROPIONIC ACID IN RUMEN FLUID





CONCLUSION

No significant interactions between fat source and silage type

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Effects of fat source:

- No effect for enteric methane and rumen parameters
- Significantly higher DMI, fat %, and yield of fat, protein and ECM for saturated fat

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- But a tendency to more negative effect on milk fat % of rape fat in maize based diets

Effects of fat source:

- No effect for enteric methane and rumen parameters
- Significantly higher DMI, fat %, and yield of fat, protein and ECM for saturated fat

Effects of silage type

- 18% lower enteric methane per kg DMI with high starch, maize based diets
- Fat %, and yield of fat and ECM were significantly lower with maize based diets
- No effect on pH and total VFA
- Increased propionic acid and decreased acetic acid with maize based diets

PRACTICALIMPLICATIONS

An iodine product of 62-68 per kg DM is far too high to obtain normal milk production even in diets with low starch

- Danish recommendation is a maximum iodine product of 45 per kg DM
- Also important to validate the total nutrient composition of the diet

THANK YOU FOR YOUR ATTENTION

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