

Feeding dairy cows in the morning or in the evening during the summer season: effects on milk production, feeding behavior, and rumen activity

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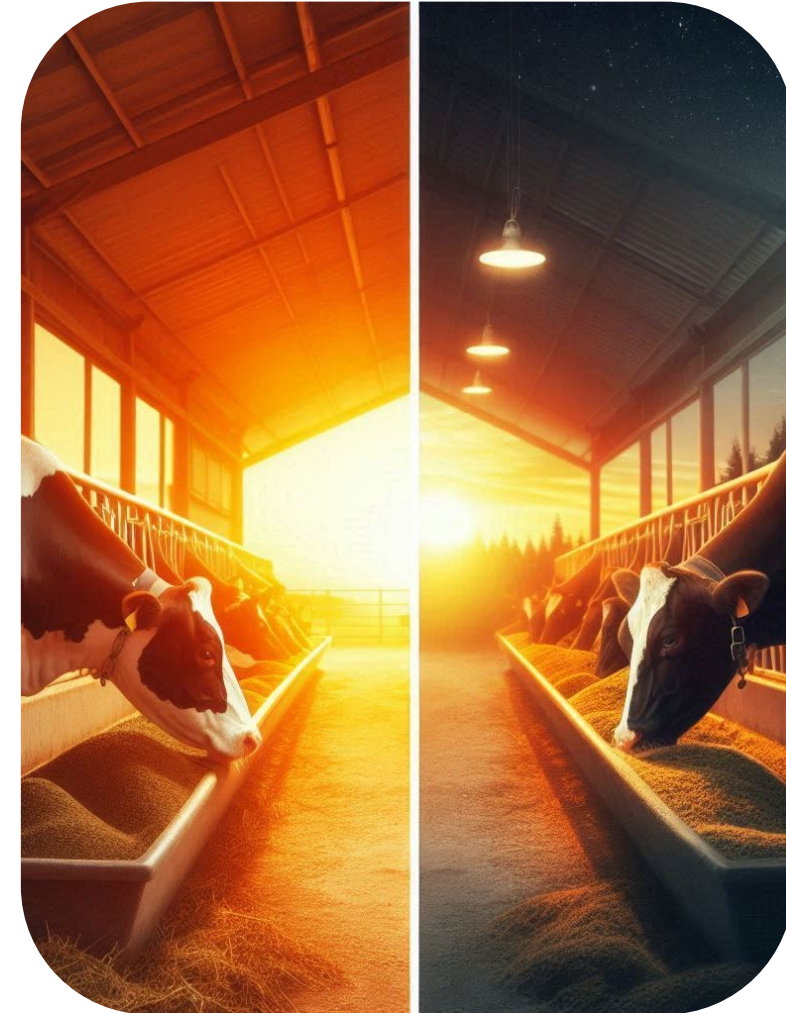
Heat stress has detrimental effects

- **Heat stress** negatively impacts the welfare and productivity of dairy cows throughout the lactation cycle (Tao et al., 2018)
- A proposed solution is to **feed cows in the evening** during summer, as it reduces **metabolic heat production** in the hottest part of the day by taking advantage of **diurnal variations** in ambient temperature and behavior (Aharoni et al., 2005; Negrón-Pérez et al., 2019)



Evening feeding has been proposed as a solution

- **Reduced rectal temperature** and **respiration rate** in cows fed in the evening vs morning-fed COWS (Calamari et al., 2013)
- **Decreased feed intake** and total-tract dry matter and NDF **digestibility**, with alterations in **feeding behavior and metabolism** – evening-fed cows consumed more feed after delivery and had greater postprandial circulating insulin (Niu and Harvatine, 2018)

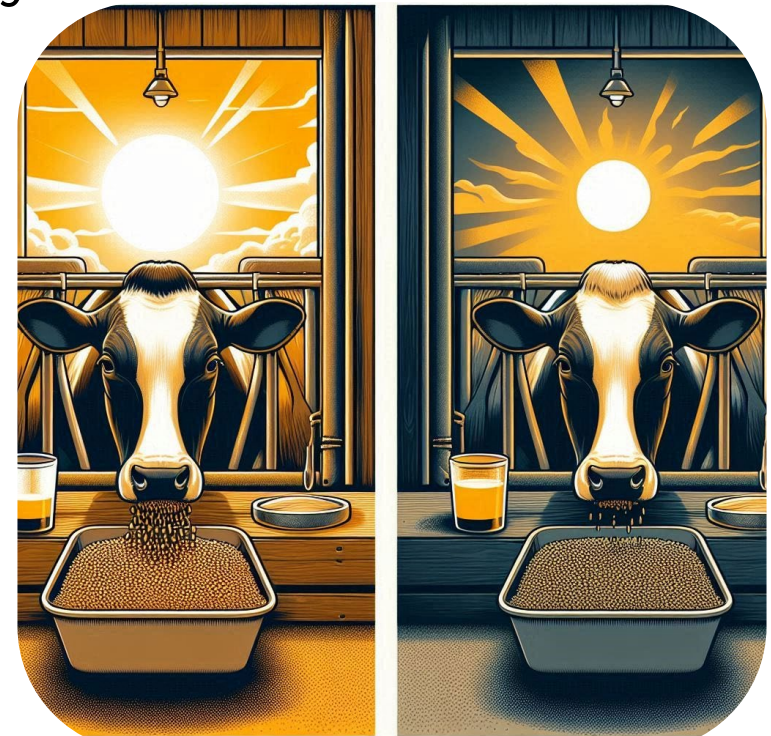


Hypothesis and aim of this study

We hypothesize that **evening-feeding** would ameliorate the response to **heat stress** in lactating cows, **shifting eating time** and the peak of rumen fermentations in the **coolest** part of the day

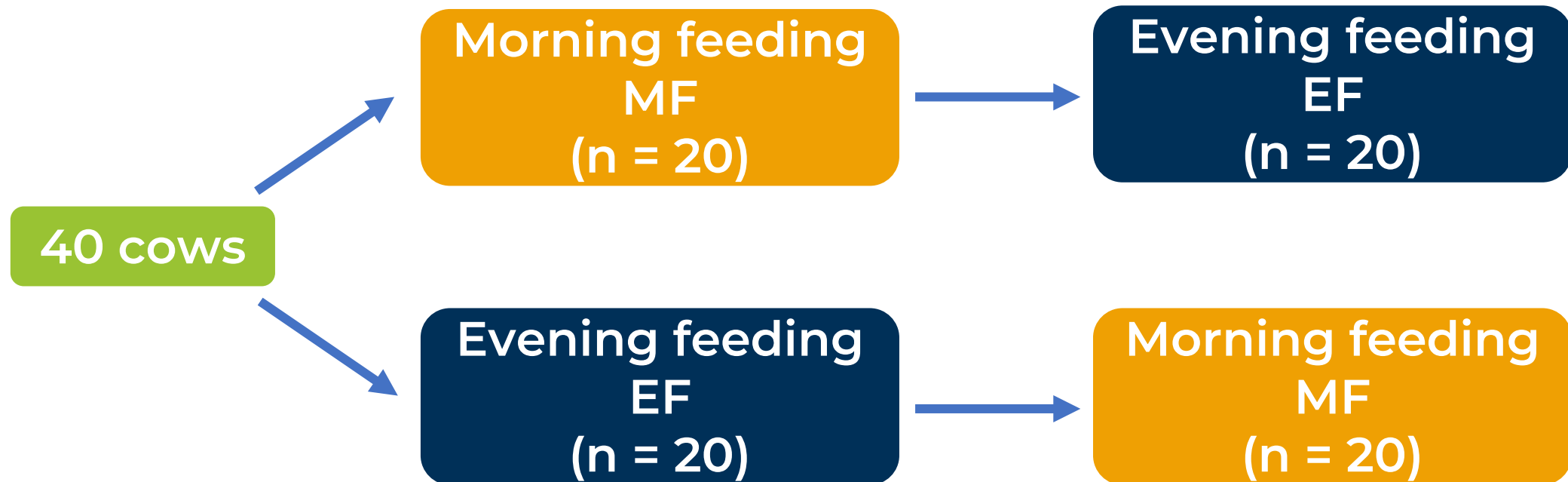
We assessed the effects of this practice on:

- Milk production
- Respiration rate
- Feeding behavior
- Rumination time
- Rumen temperature



Study design

- 40 multiparous Holstein cows, actively cooled by fans
- Cross-over design with two 14-d periods and two treatments
- TMR was delivered once a day, either in the morning (0800 h; **MF**) or in the evening (2000 h; **EF**)



Responses analyzed

- Respiration rate twice daily (0800 and 1600 h)
- Milk yield at each session (0500 and 1700 h)
- Feed intake and feeding behavior (RIC system)
- Blood samples collected 6 times over the last days of each period to capture diurnal variations of circulating insulin and glucose
- Hourly rumination and lying times (AfiCollar & AfiTagII)
- Rumen temperature and water intake (smaXtec bolus)

Statistical analysis

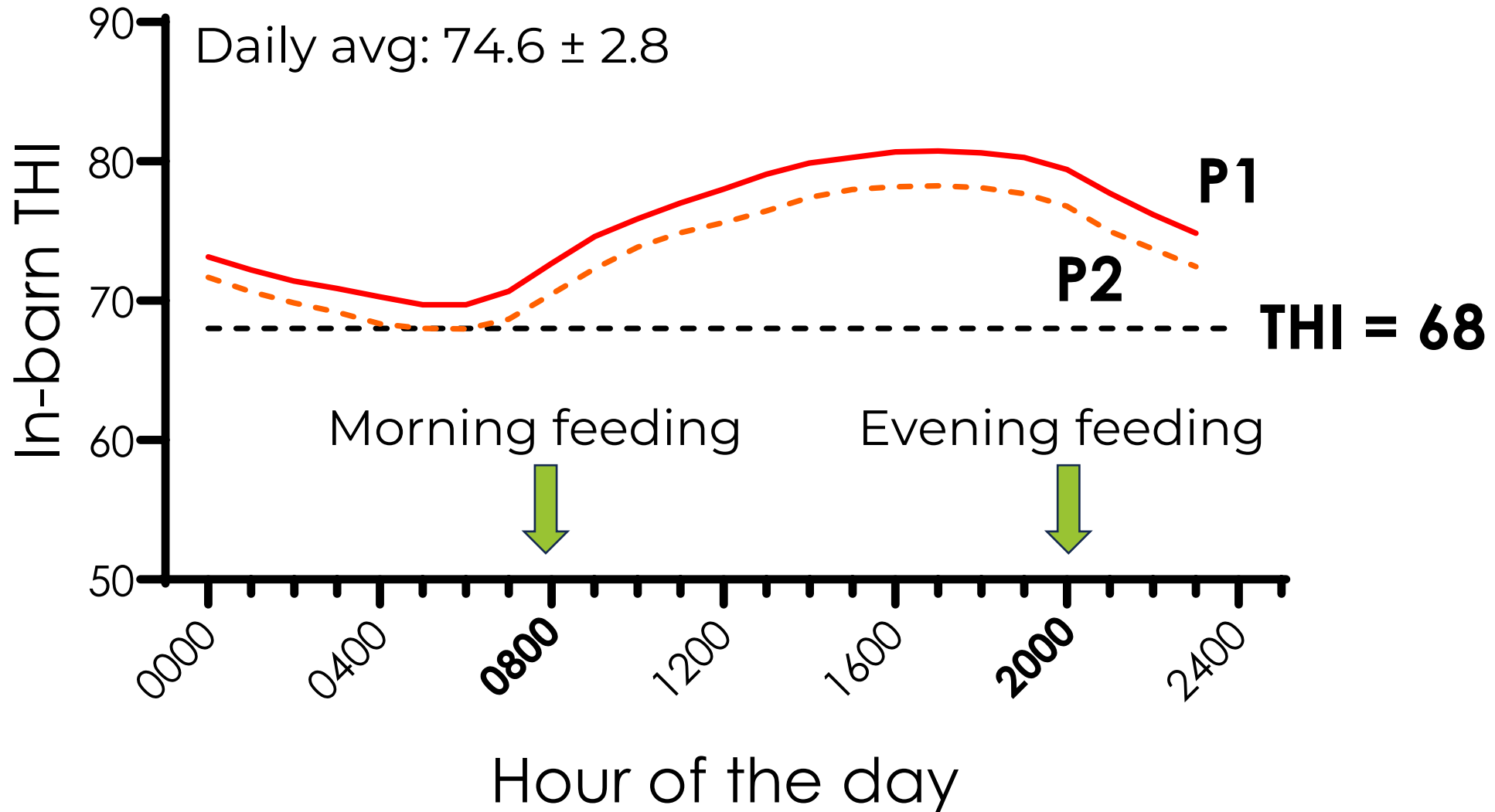
Repeated measures mixed models: **GLIMMIX** procedure (SAS)

$$Y = \text{Feed:} \textcolor{brown}{Time} + \textcolor{green}{Per} + \textcolor{blue}{Lact} + 1 | \textcolor{red}{Cow}$$

Feeding time → *Period*

Day within period ← *Lactation stage* ← *Cow effect*

Cows were heat stressed



Respiration rate was overall unaltered, but varied during the day

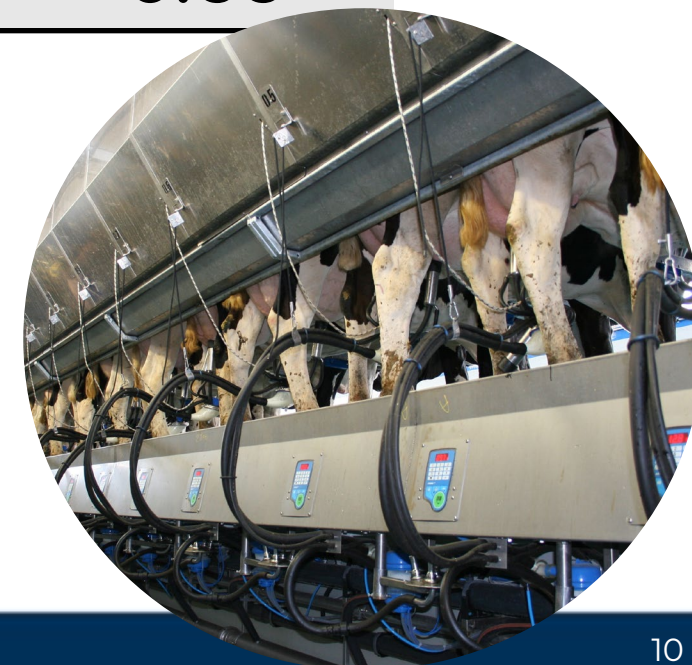
	MF		EF	SEM	<i>P</i> - value
0800 h	48.8	*	51.2	1.51	0.05
1600 h	61.9	*	59.5	1.51	0.05
avg	55.4		55.4	1.38	0.98



Different timing of metabolic heat production

Evening-fed cows produced less milk in the morning but more in the afternoon session

	MF		EF	SEM	<i>P</i> - value
morning	19.47	*	18.74	0.52	<0.01
afternoon	19.15	*	20.11	0.54	<0.01
daily	38.63		38.78	1.04	0.66



DM and water intakes were unaltered

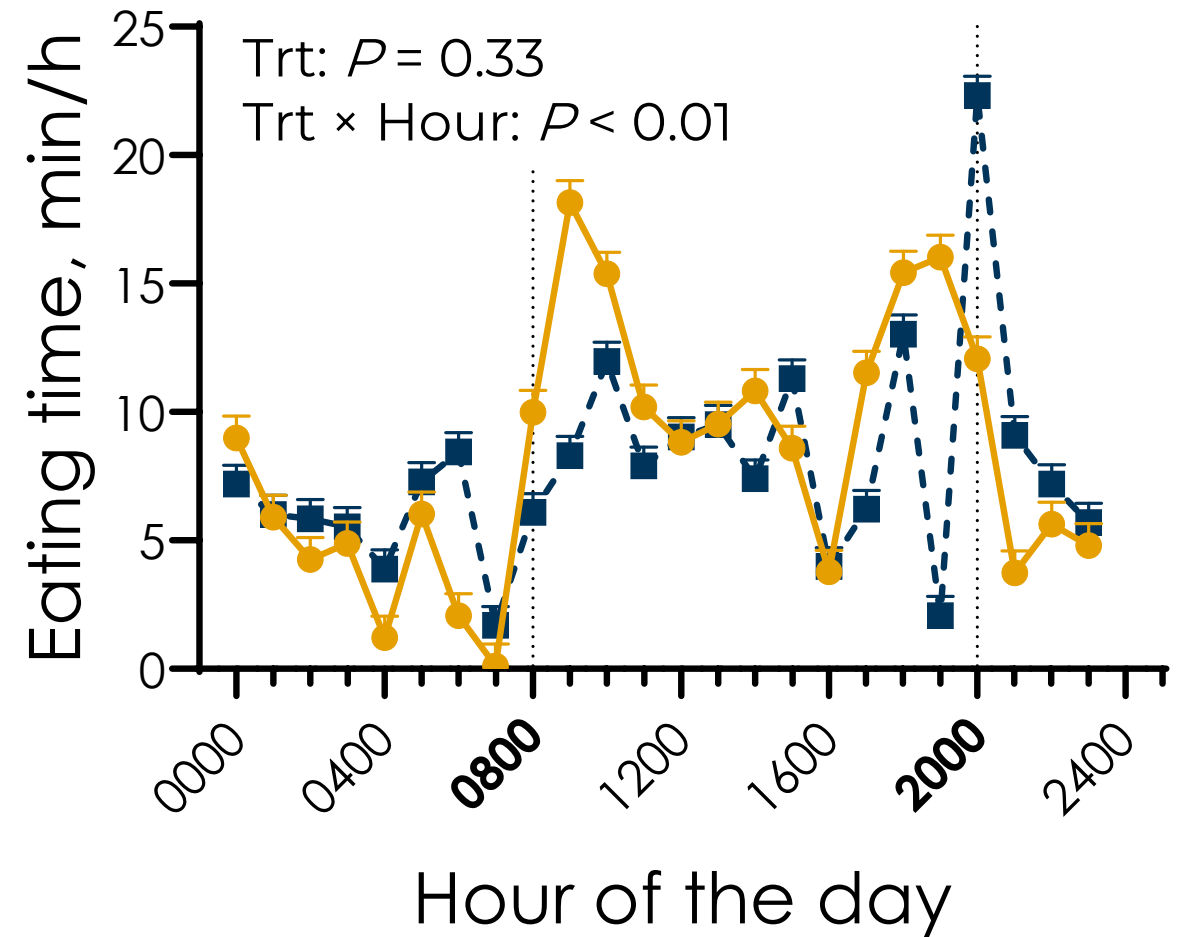
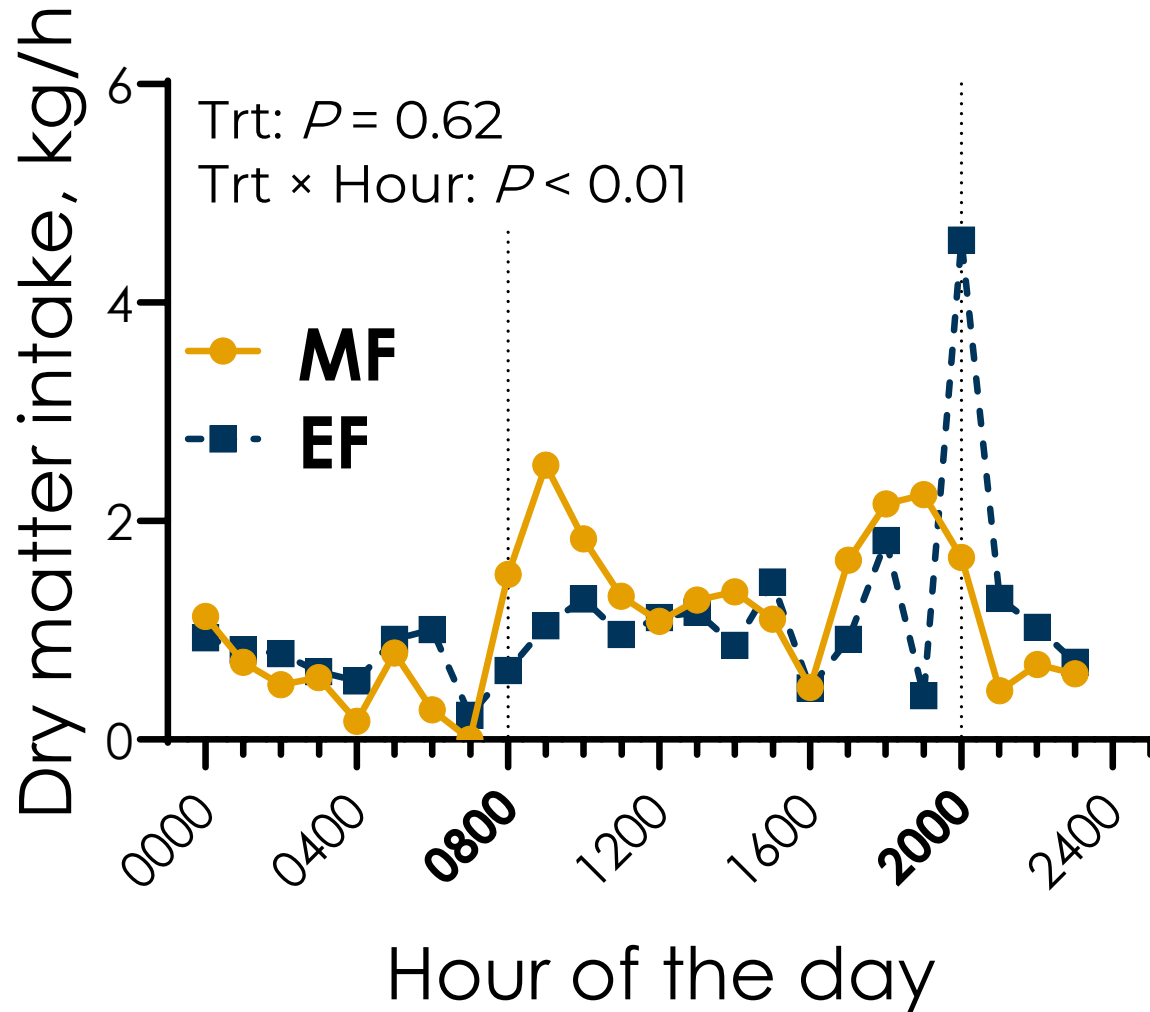
	MF	EF	SEM	<i>P</i> - value
DMI, kg	25.9	26.1	0.43	0.25
Eating time, min	201 *	190	6.17	<0.01
Water intake, L/d	87.9	89.3	3.12	0.18



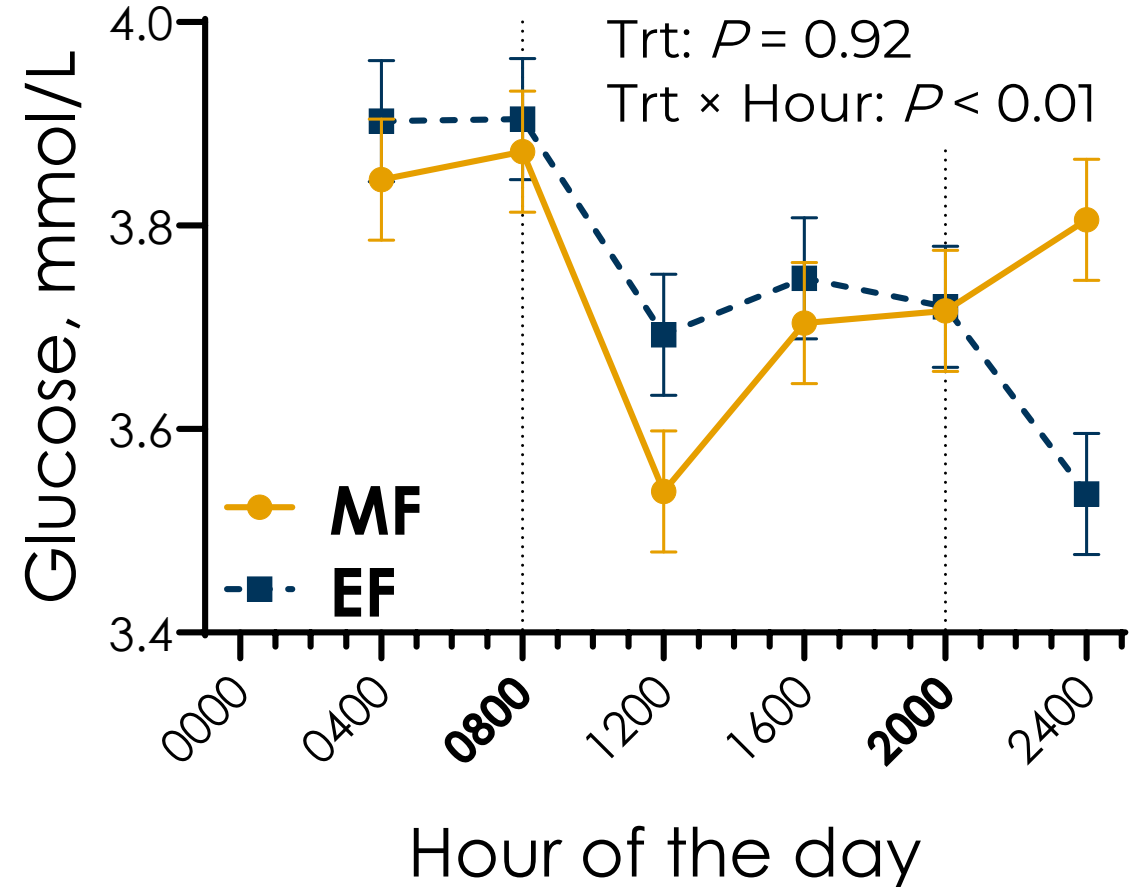
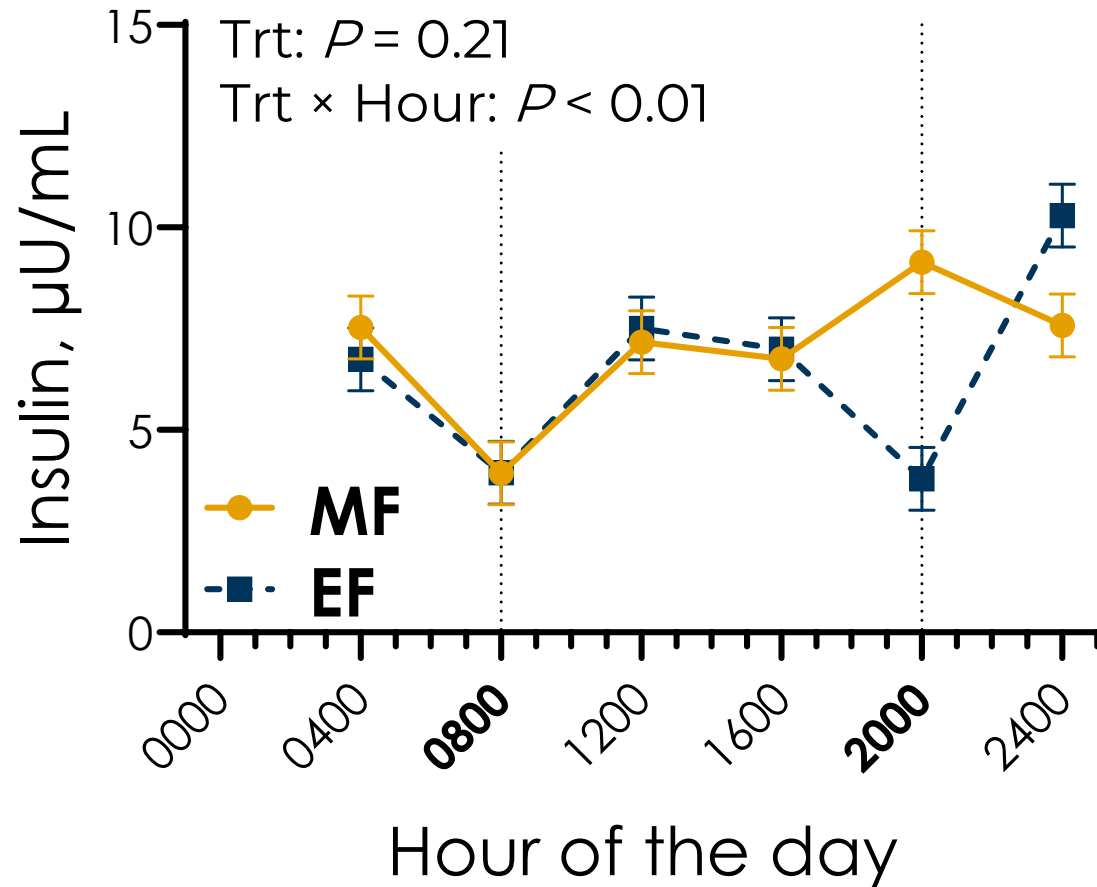
Evening-fed cows ate more and faster

	MF	EF	SEM	<i>P</i> - value
Meals, n	6.51	6.72	0.20	0.16
Visits, n	31.0	31.2	1.85	0.79
Avg meal size, kg	4.15	4.04	0.14	0.24
Avg meal time, min	31.54 *	28.50	1.07	<0.01
Eating rate, g/min	112 *	122	5.45	<0.01

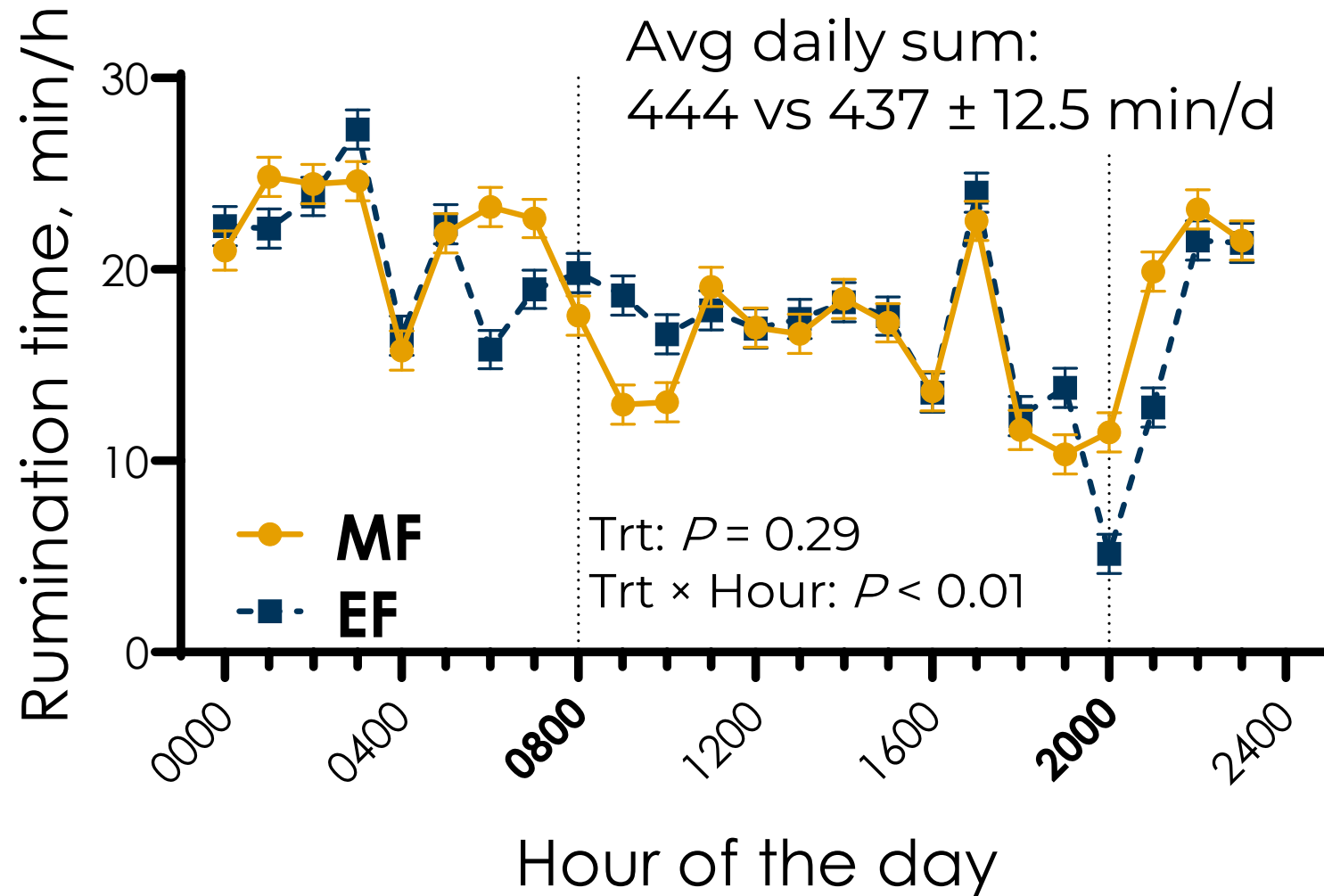
Evening-fed cows ate more and faster after delivery



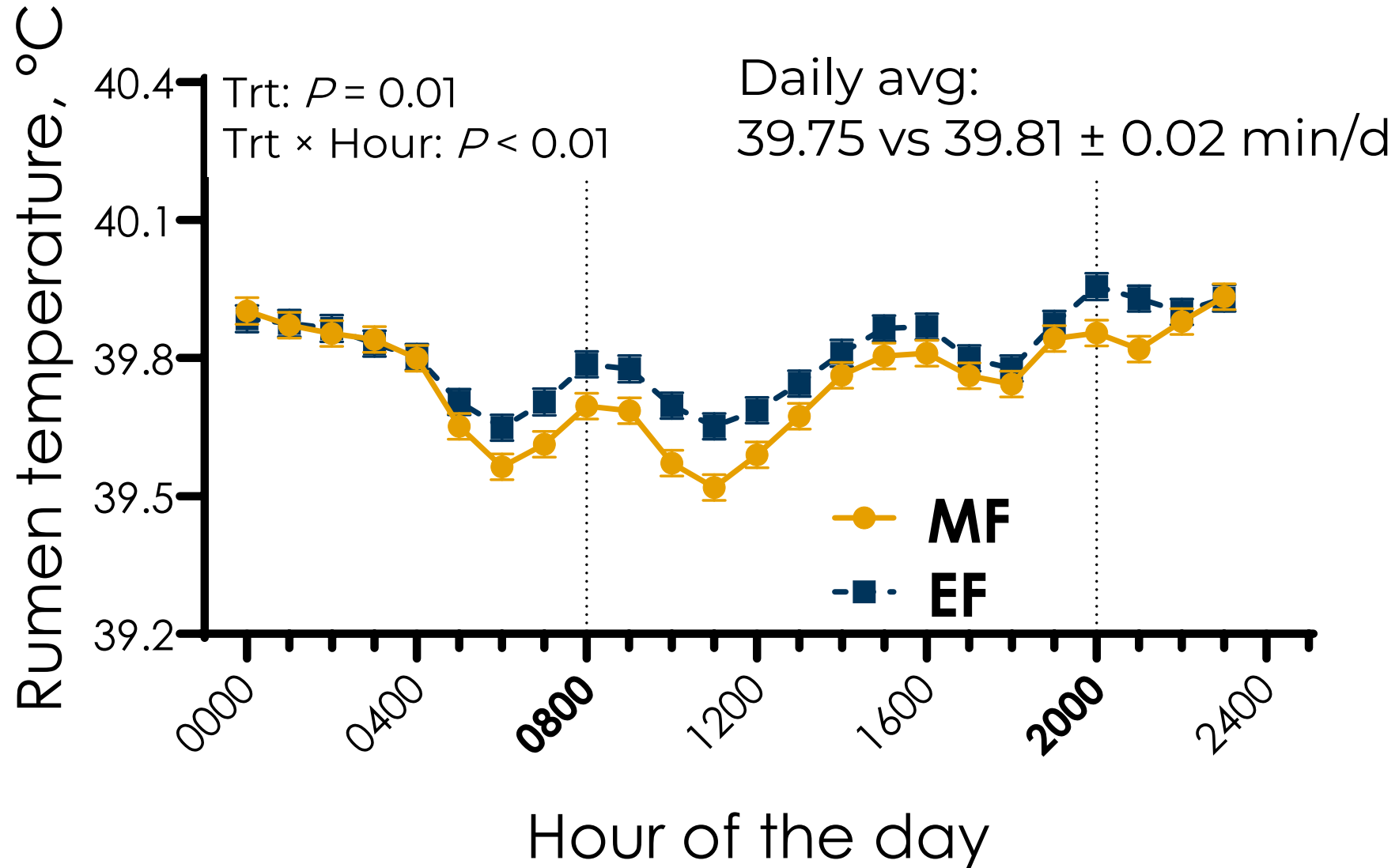
Postprandial insulin was greater and glucose lower in evening-fed cows



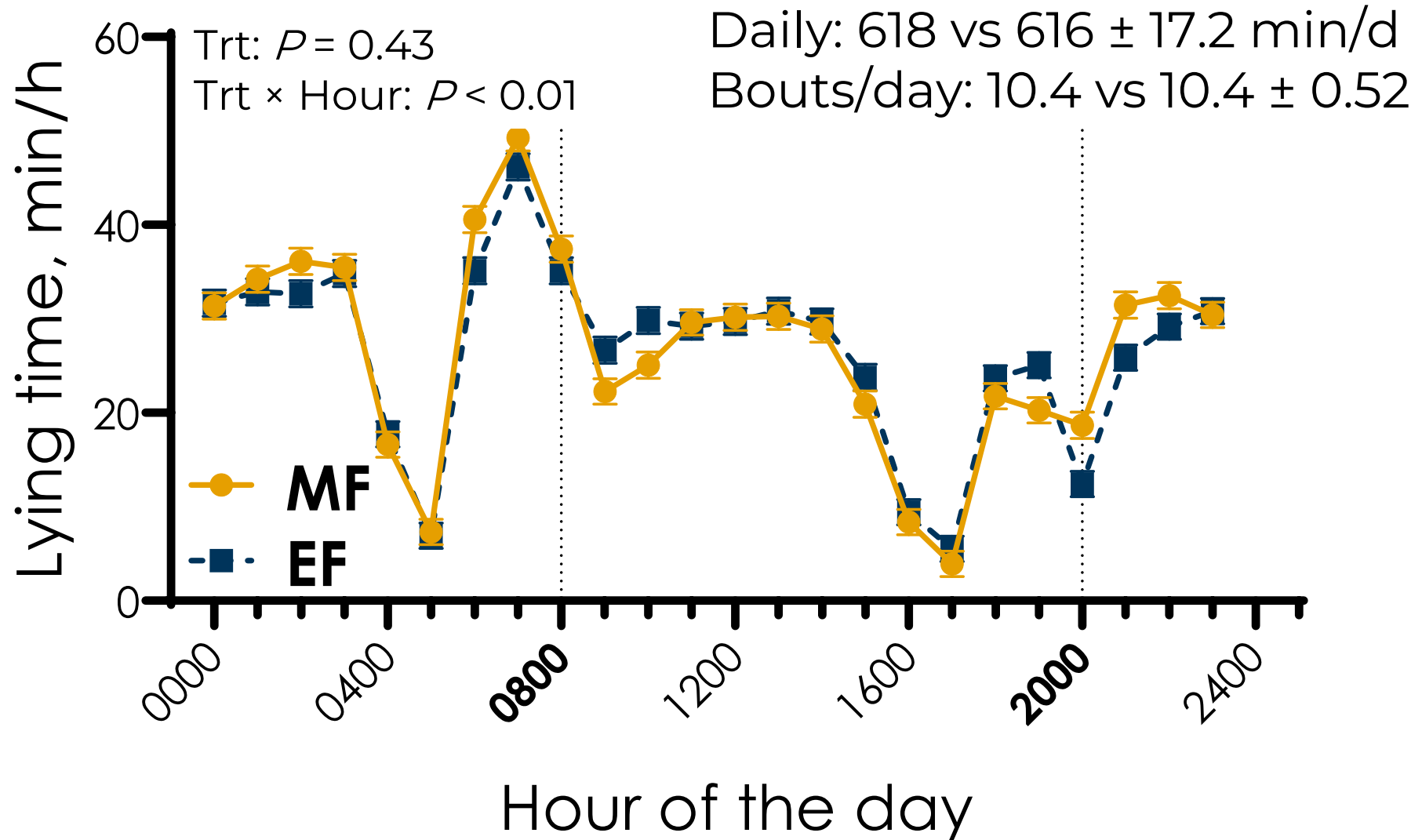
Daily rumination time was unaltered, with differences around deliveries



Rumen temperature was slightly greater in evening-fed cows



Lying time was unaltered, except around feed delivery times and during nighttime



Take home message

- Feeding cows in the evening during the summer season **did not improve milk production** nor the **responses to heat stress**
- Significant **alterations** in the feeding, rumination, and lying **behaviors** were observed
- **Evening-fed cows** ate **more feed immediately after feeding** and were **more active overnight**
- **Feed delivery stimulates eating** even during the summer season, but in this study evening feeding was **not able to mitigate** the adverse effects of high temperatures and humidity

Future perspectives

- Investigate the «full-day» metabolic profile (blood samples collected over the day)
- Investigated the hindgut fermentation profile (fecal samples collected over the day)
- Test this strategy in thermoneutral conditions



Thanks for your attention

Questions?

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