Comparison of hays harvested at three stages of grass maturity in their effects on chewing activity and ruminal pH fluctuation of cows

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ADSA – ASAS – CSAS 2005 Joint Annual Meeting, July 24 – 28, Cincinnati, Ohio

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In dairy cow diets, hay is often used as a source of effective fiber in order to maintain rumen function.

The physical effectiveness of hay is related to various factors, e.g.:

- **Particle size**
- **Botanical composition**
- **Stage of maturity**

Objective

Effect of an immature hay versus two mature hays harvested after different periods of regrowth on

- ➔ **Nutrient intake**
- ➔ **Chewing activity**
- ➔ **Rumen pH**

Material and Methods

Animals

- 6 non-lactating cows
- ruminally cannulated
- Brown Swiss breed
- body weight: av. 650 kg
- kept in individual stalls

Experimental design

- double 3 x 3 Latin square
- 14 d adaptation period and 7 d collection period

Hay

- second cut of a permanent meadow
- 55% ryegrass, 23% white clover, 22% dandelion
- harvest at 36 d after regrowth **(A, control)**
  50 d after regrowth **(B)**
  61 d after regrowth **(C)**
- fed as long hay

Nutrient composition g/kg DM			
	Hay A	Hay B	Hay C
NDF	433	448	450
ADF	264	291	298
ADL	34	41	47
Sugar	100	96	86
Crude protein	153	142	137

Treatment

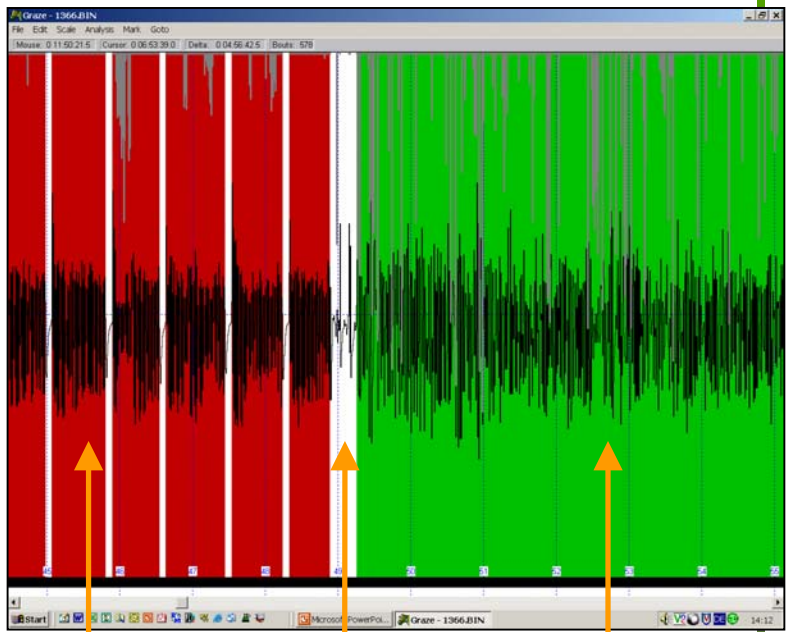
	Hay A	Hay B	Hay C
Feeding			
Mineral supplement (0730 h)	300 g/d	300 g/d	300 g/d
Hay (0800 h)	ad libitum	ad libitum	ad libitum

Material and Methods

Continuous recording of chewing activity

Flexible noseband with sensors

Data recorder



Ruminating

Not defined (Idling)

Eating

- **Continuous recording over 22 h (1500 h to 1300 h) for 5 d**
- **Extrapolation of the data to 24 h**

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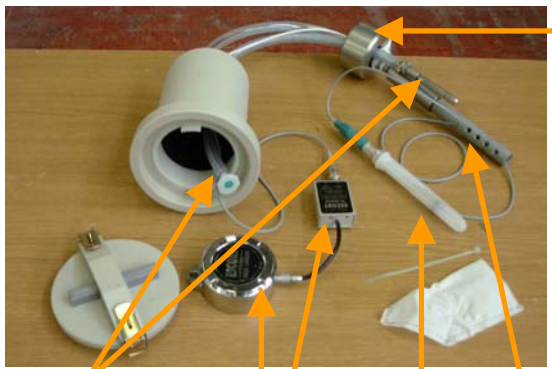
Continuous recording of rumen pH

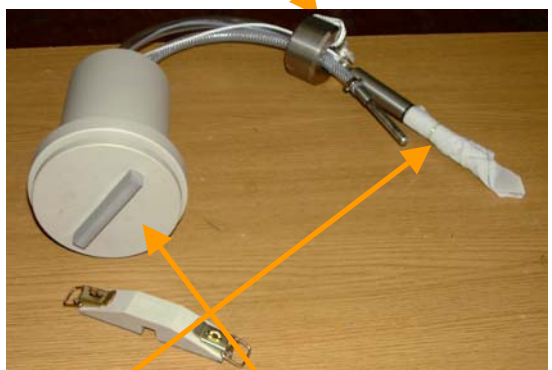


Device for sampling rumen fluid

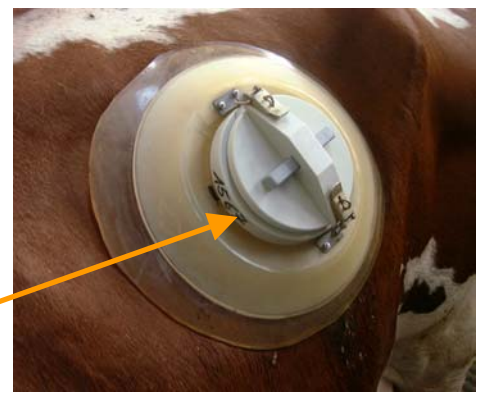
pH-electrode

Data recorder Adaptor

Weight



Protective cover for the electrode



Stopper for the inner flange of the cannula

- **Continuous recording over 22 h (1500 h to 1300 h) in 30 s intervals for 5 d**
- **Separation of the data into a day and a night period**
- **Calculation of the minimum, maximum and mean pH values and the time pH was below 6.2**
- **Calibration of the electrode and transfer of the data once a day**

Check of the continuous measurements of the rumen pH

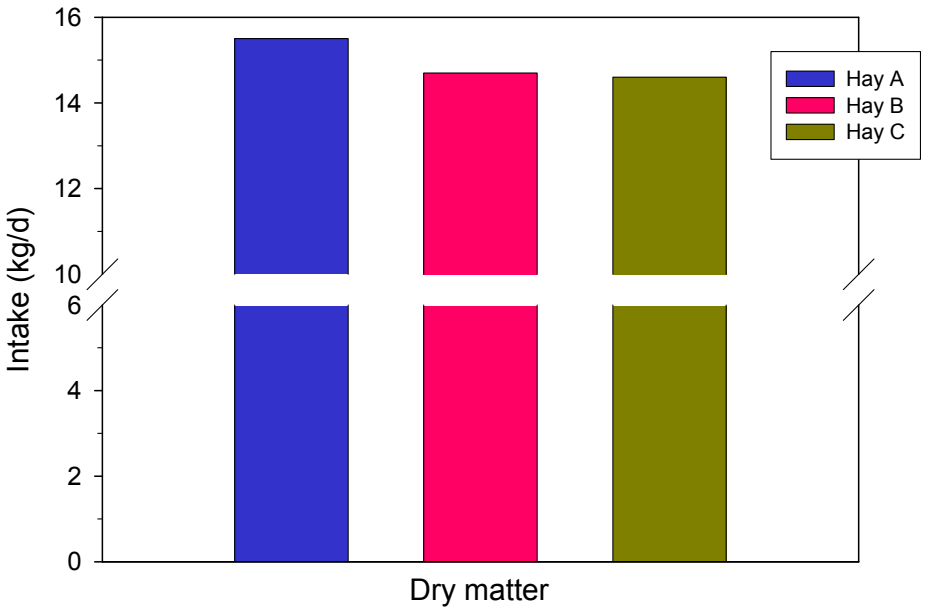
- Measurements of the pH of rumen fluid outside the rumen
  - on d 3 to 5 of each collection period
  - every 2 hours from 0700 to 1900 h

Statistical analysis

- Analysis of variance designed for a double 3 x 3 Latin Square design
- Conduction of the treatment comparisons by orthogonal contrasts
  - hay A versus hays B and C
  - hay B versus hay C

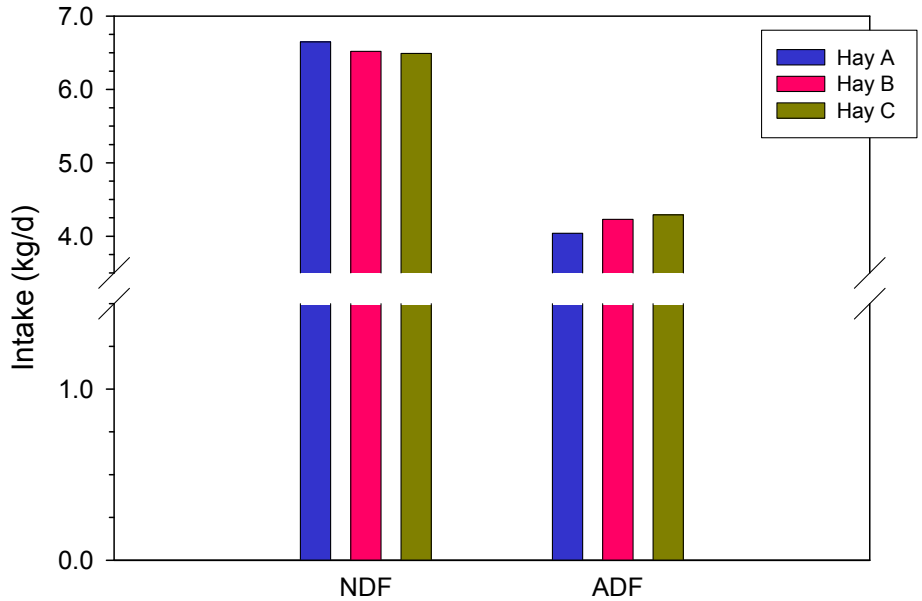
Results

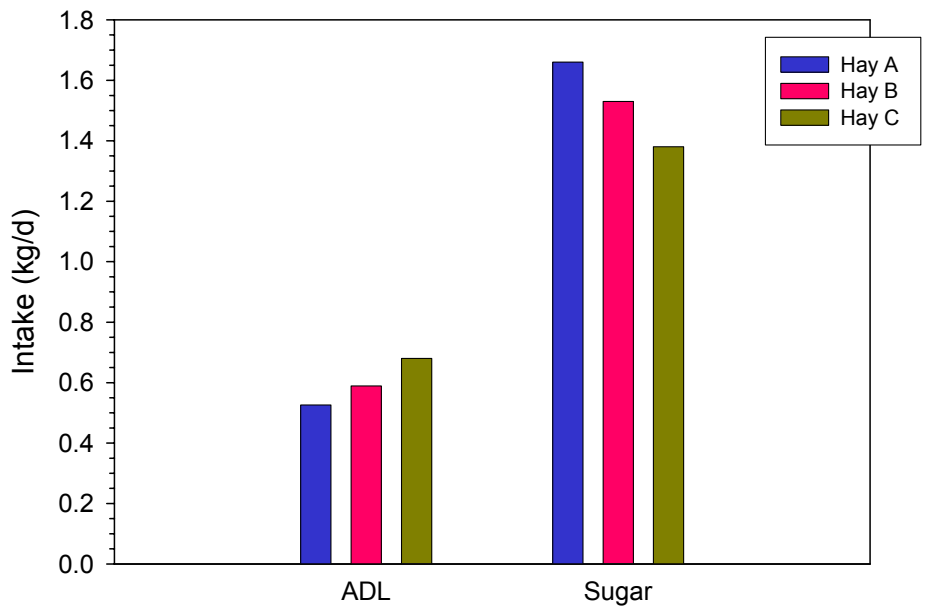
Nutrient intake



AAvss.BBandCC; *P*<0.0001

CCvss.BB; *P*=0.0068





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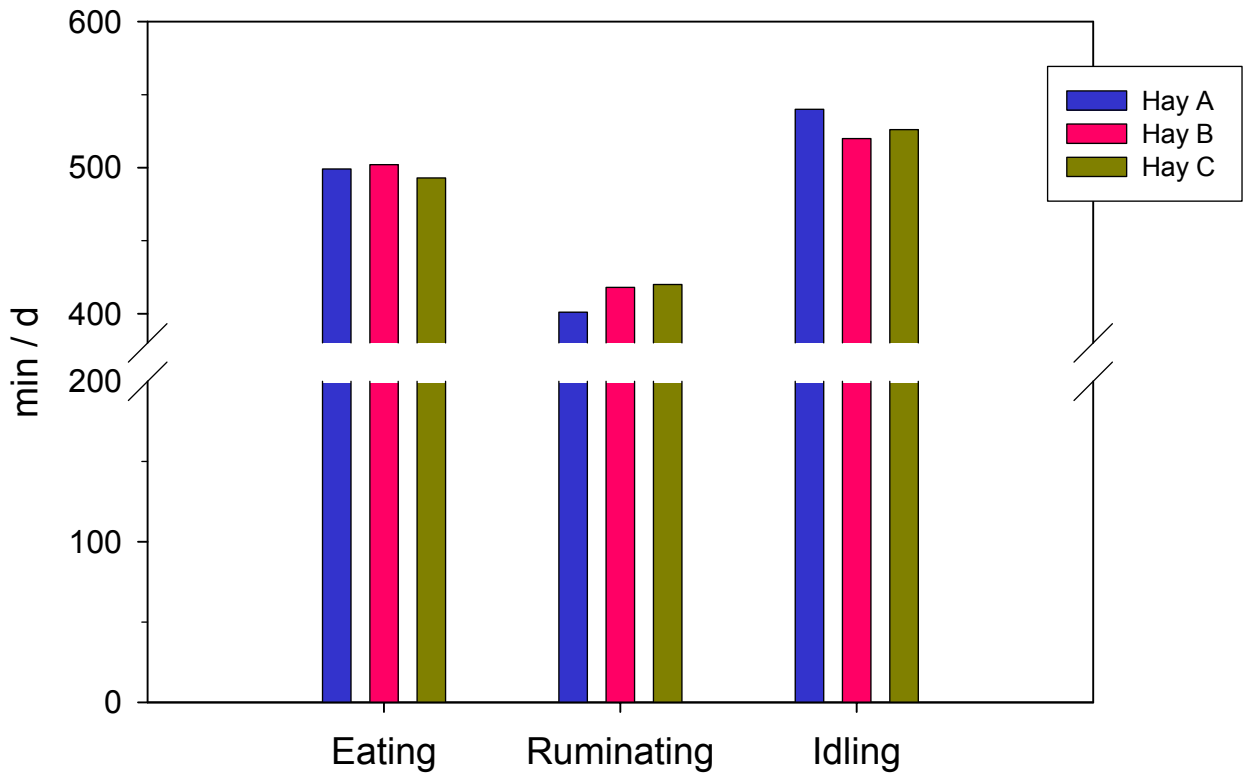
Results

Chewing activity per day



A vs. B and C; $P = 0.12$
C vs. B; $P = 0.57$

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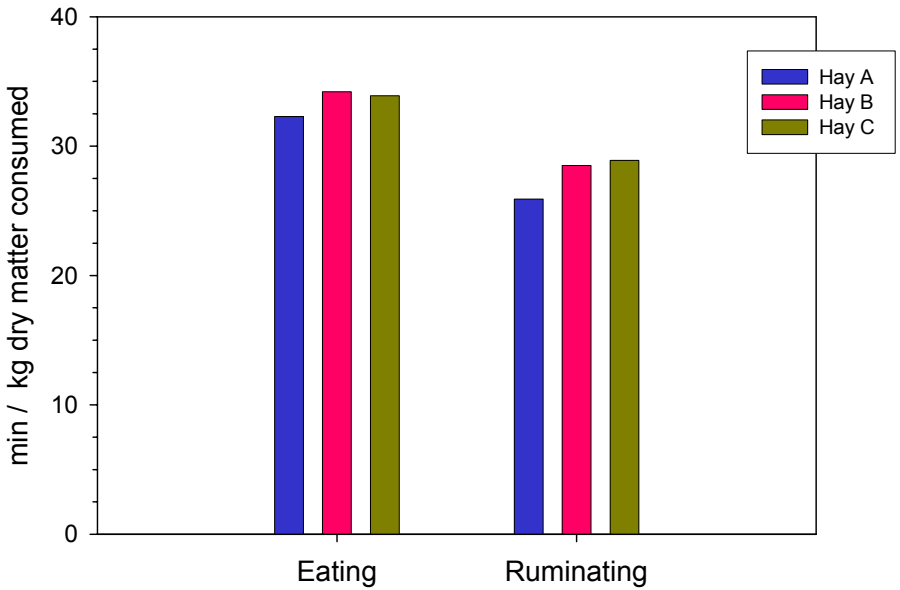
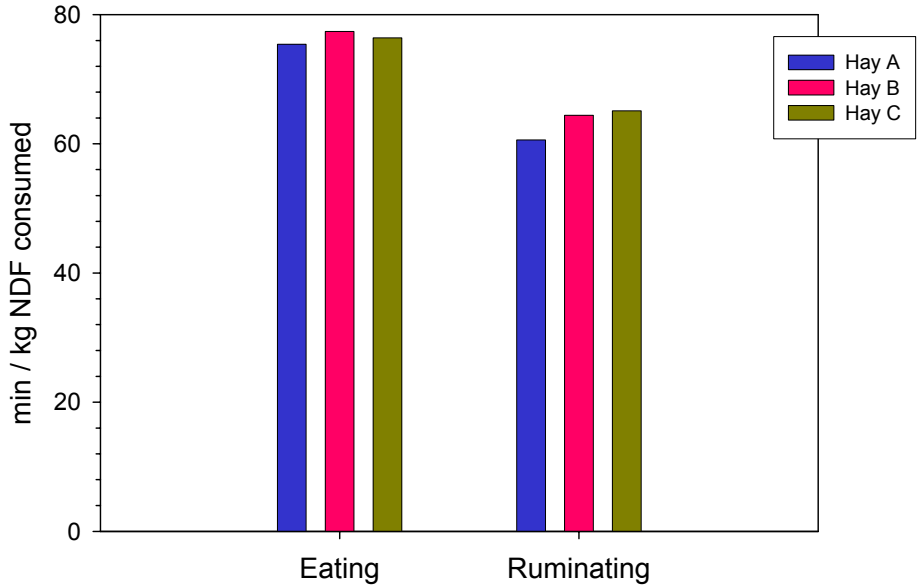
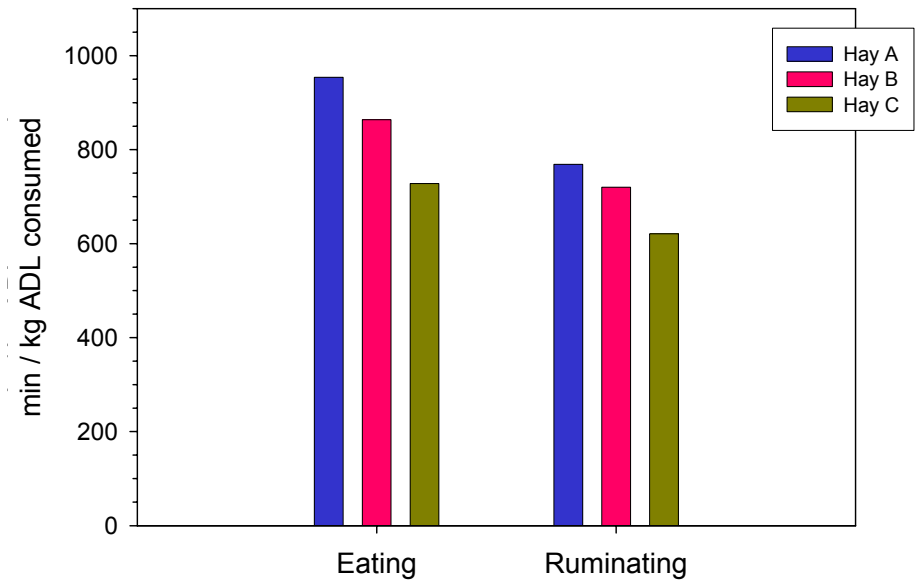
Results

Chewing activity







A vs. B and C; $P < 0.001$
C vs. B; $P < 0.001$

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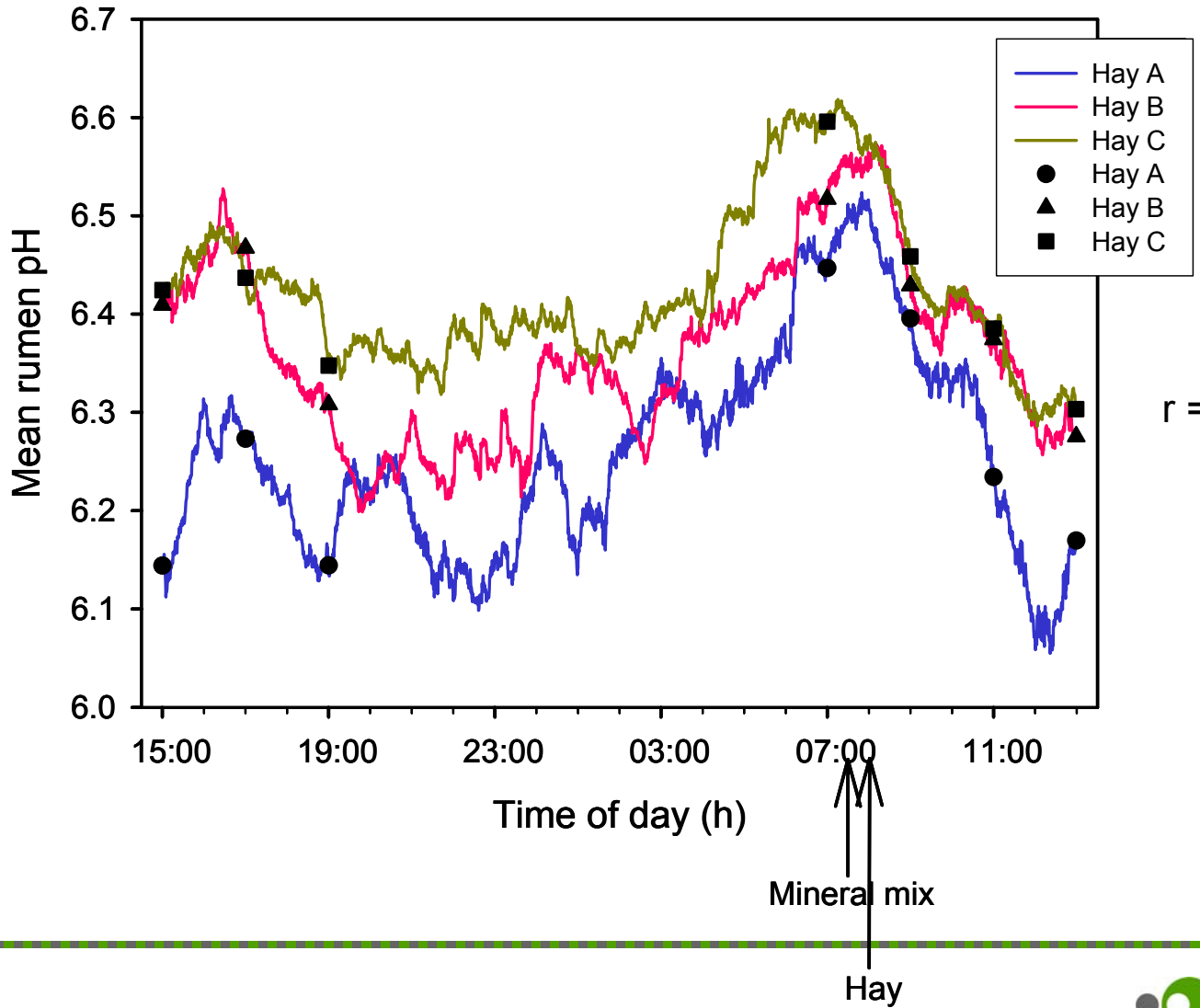
Rumen pH of the continuous measurements

Daytime (0700 – 1900 h)	Hay A	Hay B	Hay C	Orthogonal contrasts A vs. B and C	Orthogonal contrasts C vs. B
Mean	6.27	6.41	6.44	< 0.05	0.69
Maximum	6.57	6.65	6.64	0.19	0.88
Minimum	5.97	6.15	6.23	< 0.05	0.39
Time < 6.2, min / d	220	56	68	< 0.05	0.86

Nocturnal (1900 – 0700 h)	Hay A	Hay B	Hay C	Orthogonal contrasts A vs. B and C	Orthogonal contrasts C vs. B
Mean	6.25	6.33	6.42	0.08	0.23
Maximum	6.57	6.61	6.67	0.25	0.39
Minimum	6.00	6.00	6.19	0.35	0.14
Time < 6.2, min / d	282	160	84	0.05	0.70

Results

Diurnal fluctuations of rumen pH



r = 0.80; $P < 0.001$

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Summary

* **Comparison of the immature hay with the two mature hays**
  - ↑ intake of DM
  - ↓ ruminating time per day and per kg DM and NDF consumed
  - ↓ intake of ADF and ADL
  - ↑ eating and ruminating time per kg ADL consumed
  - ↑ intake of sugar
  - ↓ mean and minimum rumen pH during the day
  - ↑ time when the pH was < 6.2

* **Comparison of the two mature hays**
  - the intake of ADL increased with increasing maturity
  - the time spent eating and ruminating per kg ADL consumed decreased with increasing maturity

Conclusion

In conclusion, the reduced rumen pH with the immature hay could be explained by the higher sugar intake ($r = -0.67$; $P < 0.01$).

The few differences between the two mature hays could be explained by the very similar nutrient composition.

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