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Effects of a sequential offer of hay and TMR on feeding and rumination behaviour of dairy cows

3rd Dairycare Conference, Zadar, 4th October 2015

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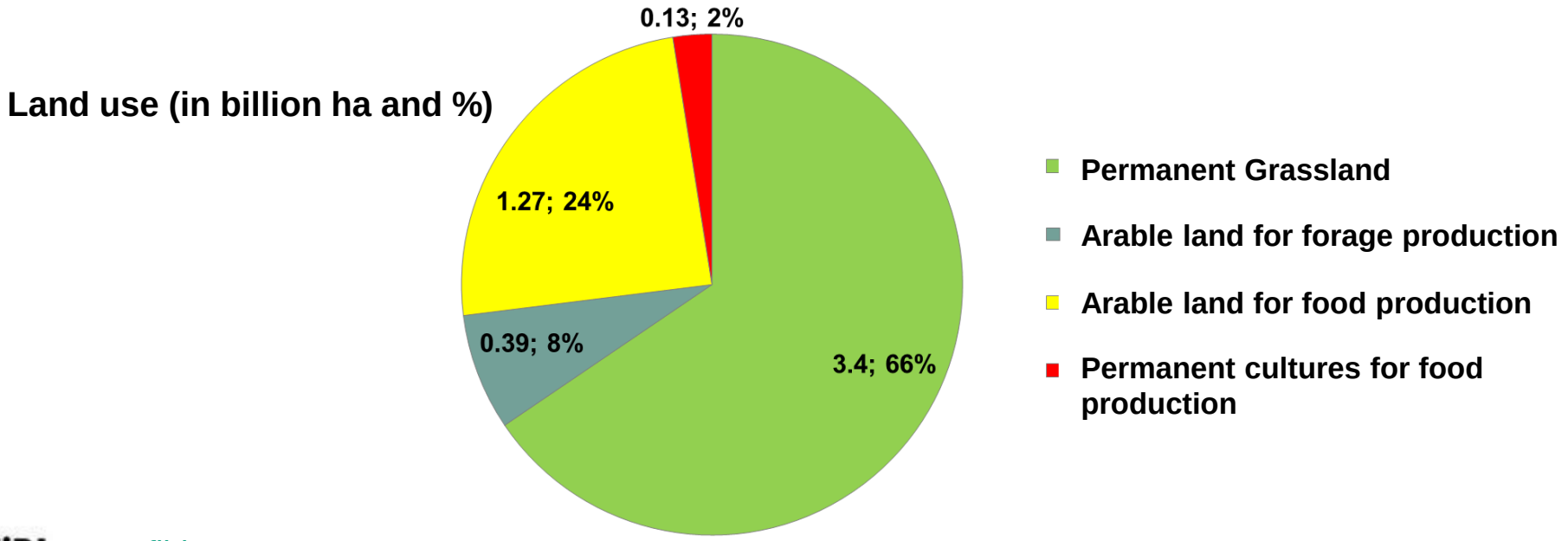
Introduction: background: grassland utilisation

Grassland-based ruminant production:

- **A matter of global nutrient resource efficiency**
  - less feed-food competition for arable land
  - less need in protein concentrates, shifts across the globe
- **A matter of ecological resources**
- **At least grassland-rich regions are challenged to make better use of this resource (e.g. Switzerland)**



Introduction: background: concentrate reductions

- **Switzerland: GMF («Grassland-based milk and meat production»)**
  - **Min. 75% of the feed must come from grassland resources (including artificial grasslands within crop rotations). This means: maize silage + concentrates = max. 25% of the diet.**
- **Switzerland: organic standards of BioSuisse**
  - **Min. 90% roughages in milk production (calculated per herd and year).**

- **But: differentiated feeding management options for concentrate-reduced production systems are lacking.**

Introduction: roughage based feeding management

- Which management options exist for a zero- or low-concentrate-strategy?
  - Production, storage and feeding of different roughage qualities
  - How to increase roughage intake by feeding management?
    - Diversity on pastures?
    - TMR or separate offers?
    - Performance-groups?
- Which parameters do we measure to assess feeding situations?
  - Only feed quality and animal performance?
  - Or additionally animal related parameters like feeding behaviour, faeces quality and BCS?

Introduction: Aims of the project

- **Evaluating in one experiment:**
  - **Roughage-based feeding management options**
    - **concentrate reductions**
    - **sequential offer of different roughages**
  - **Animal-related assessment parameters (feeding behaviour)**
    - **Eating and rumination behaviour**
    - **Faeces particle composition**

Methods: animals / farm

- **Organic dairy farm near Berne, Switzerland**
- **Swiss Fleckvieh (average performance: 7000kg milk / a)**

Methods: barn

Methods: experimental schedule

- 2 groups of 15 cows each
  - «Prot+»: 2.4 kg individually fed concentrates / cow / day
  - «Prot-»: 0 kg individually fed concentrates
  - Excluded animals: 3 in Prot+, 4 in Prot-

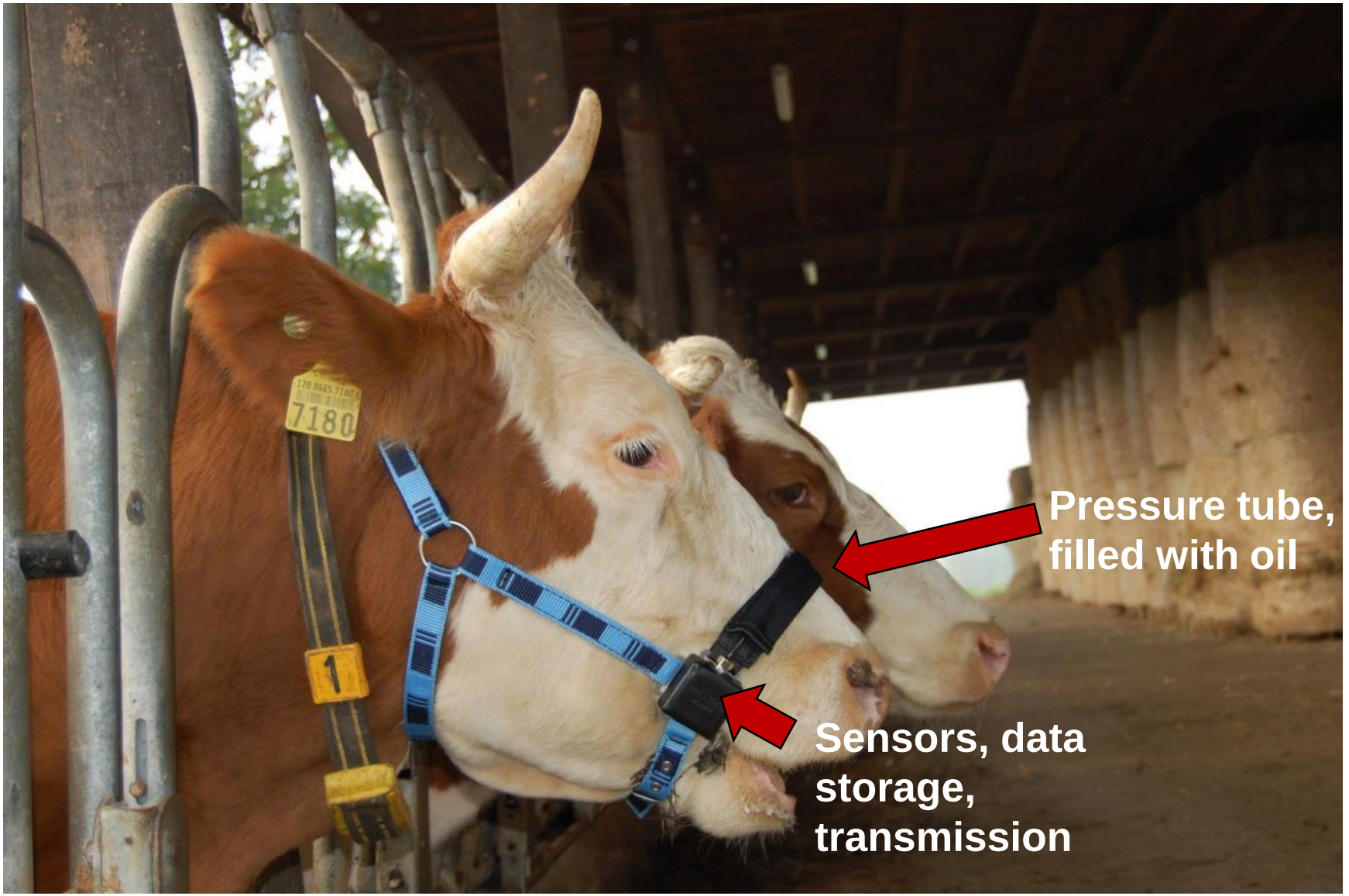
- 2 experimental periods (21 days each)
  - Period 1: TMR1 *ad libitum* for all cows
  - Period 2: TMR2 *ad libitum* for all cows; 6.00 a.m.- 8.00 a.m. hay *ad libitum* for all cows

Materials: diets

- **TMR1:**
  - 0.30 maize silage,
  - 0.32 grass silage,
  - 0.21 hay,
  - 0.09 dried alfalfa meal,
  - 0.05 potatoes
  - 0.03 soybean cake.

- **TMR2:**
  - 0.35 maize silage,
  - 0.38 grass silage,
  - 0.06 hay,
  - 0.11 dried alfalfa meal,
  - 0.06 potatoes
  - 0.04 soybean cake

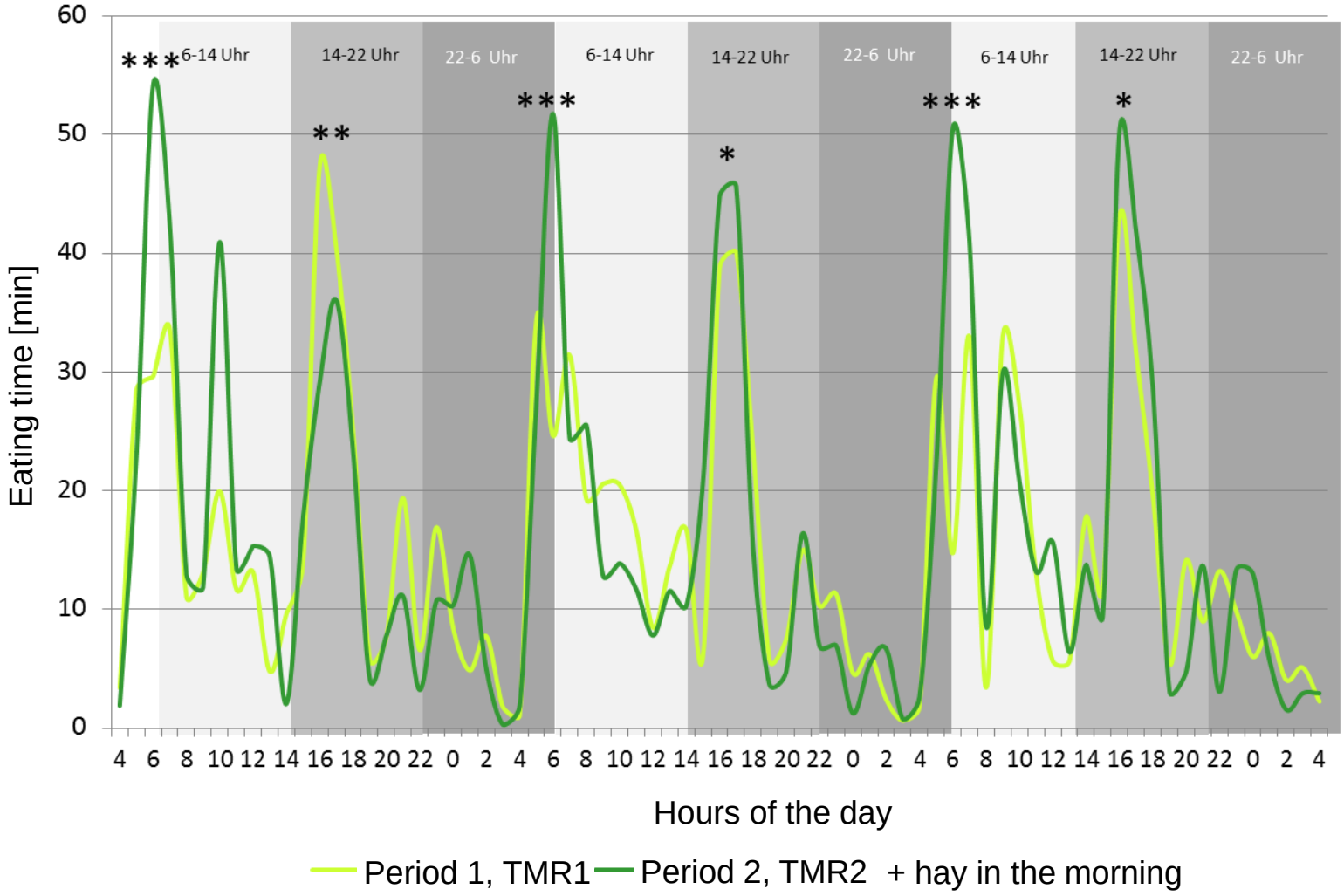
Materials: RumiWatch® chewing sensors



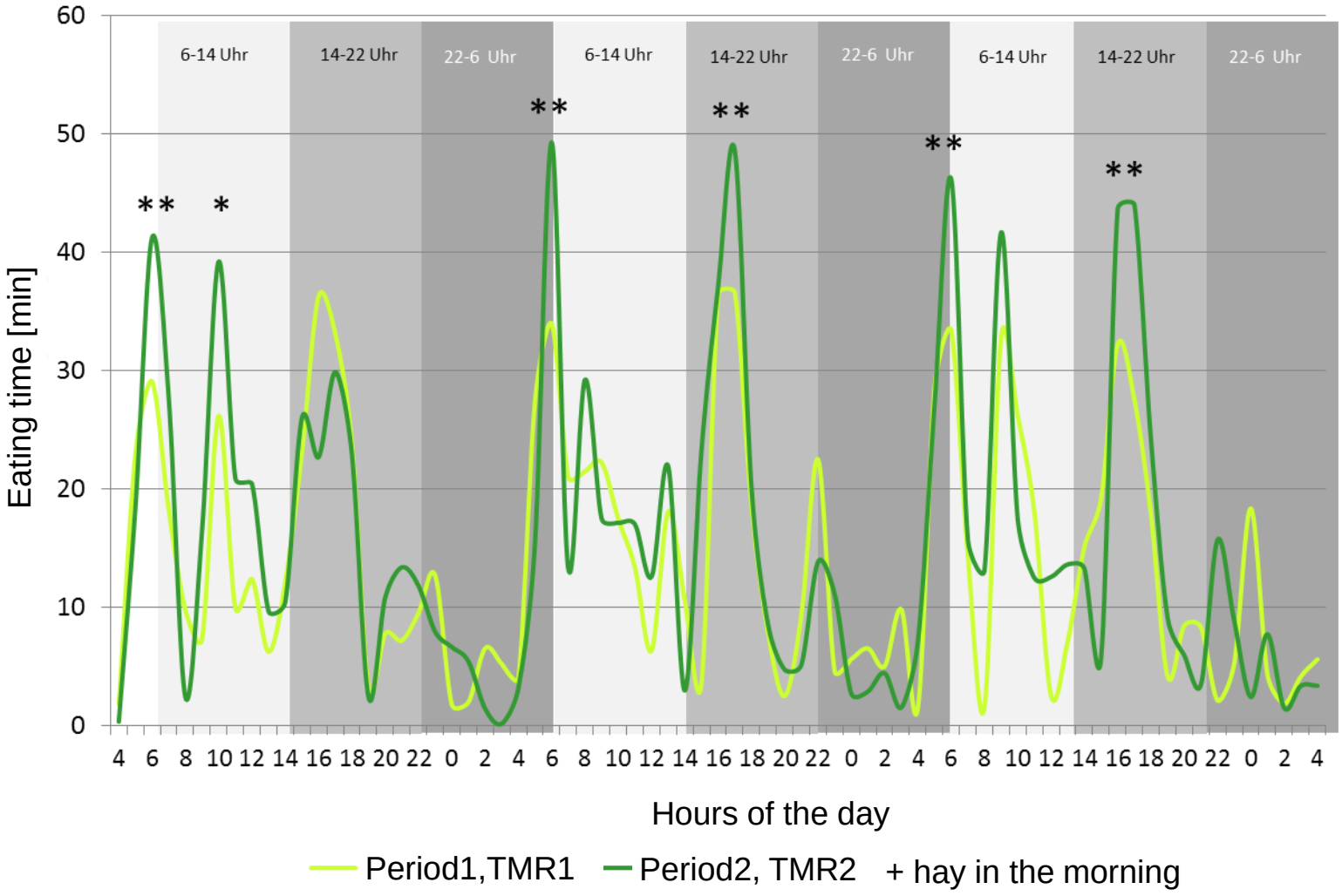
Methods: sampling

- **Sampling weeks in days 17-21 of each period**
  - **Individual feed intake hand weighed, daily**
  - **Feed samples twice per week**
  - **Milk yield and sampling: twice per week**
  - **Chewing sensors: 96h per week (72h used for analysis)**
  - **BCS and body weight: once per week**

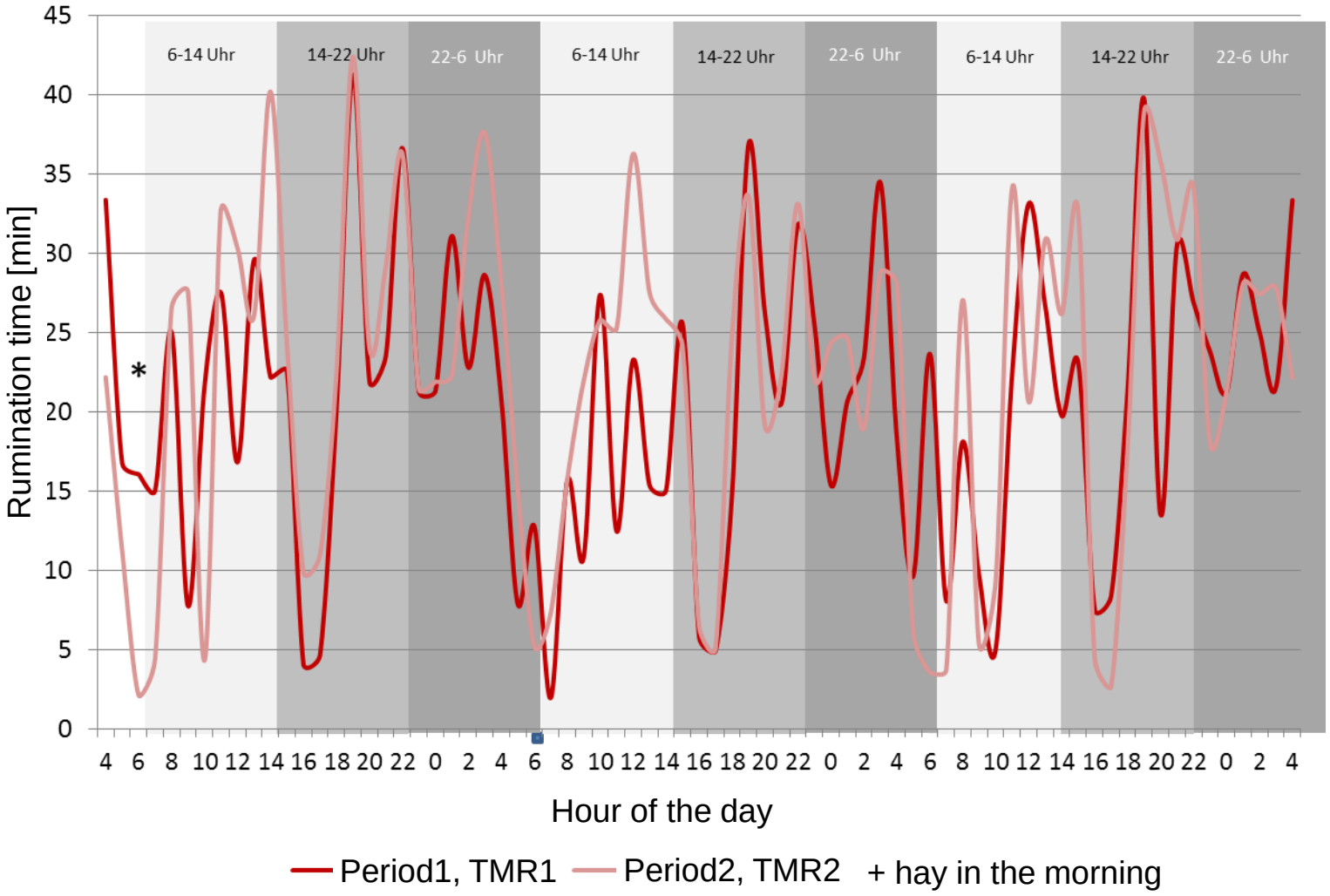
Results: eating pattern (group Prot+)



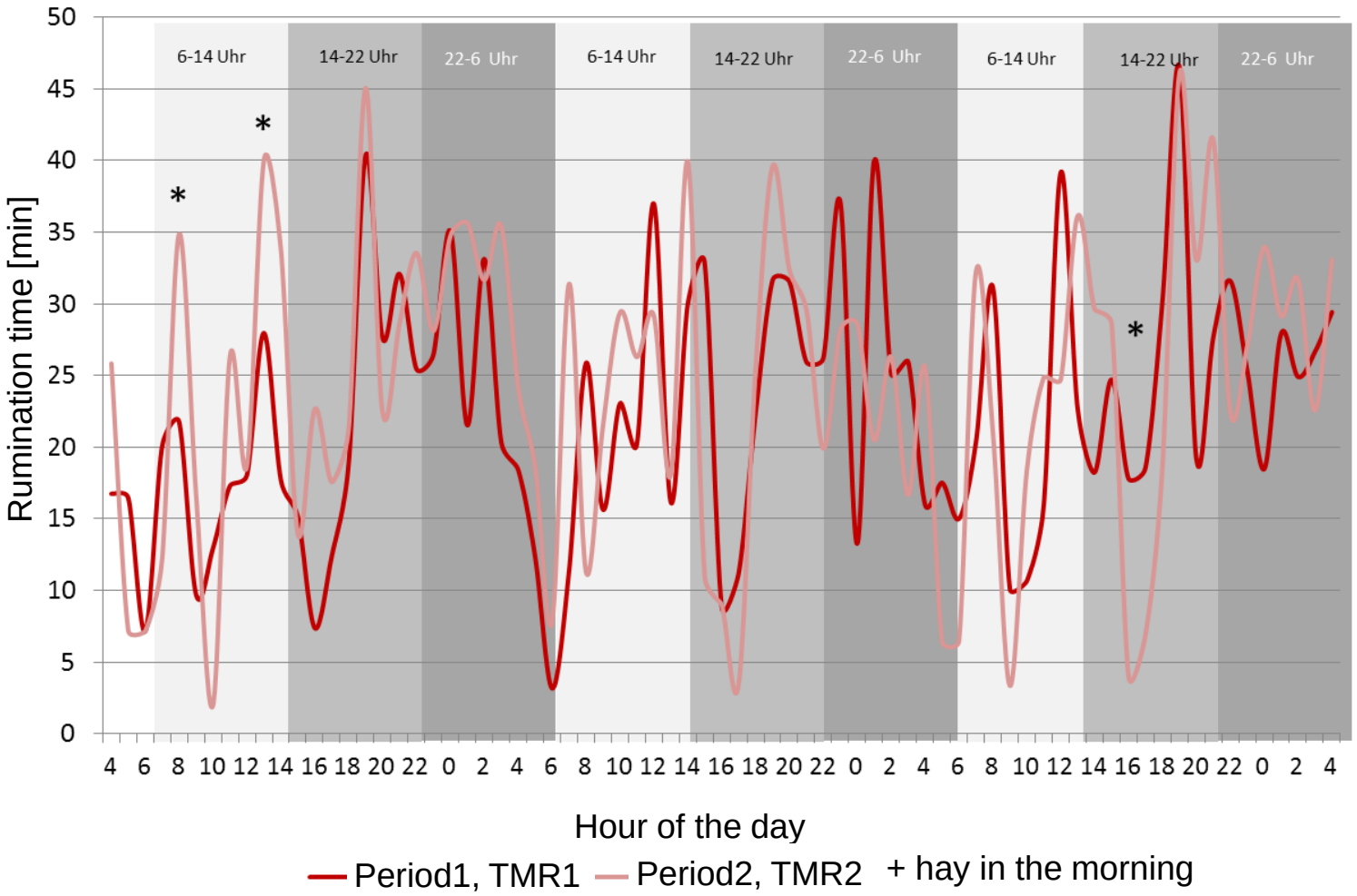
Results: eating pattern (group Prot-)



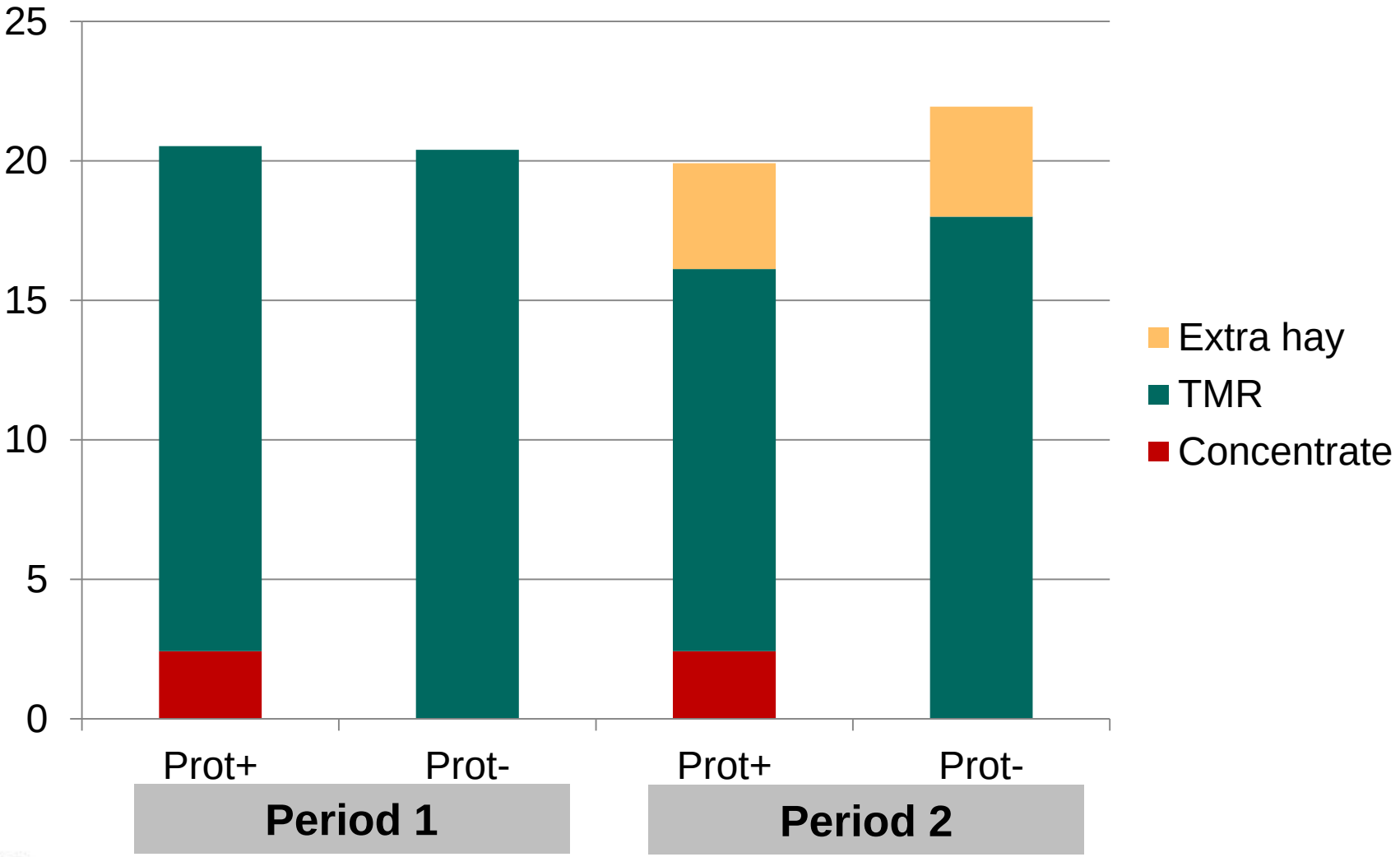
Results: rumination pattern (group Prot+)



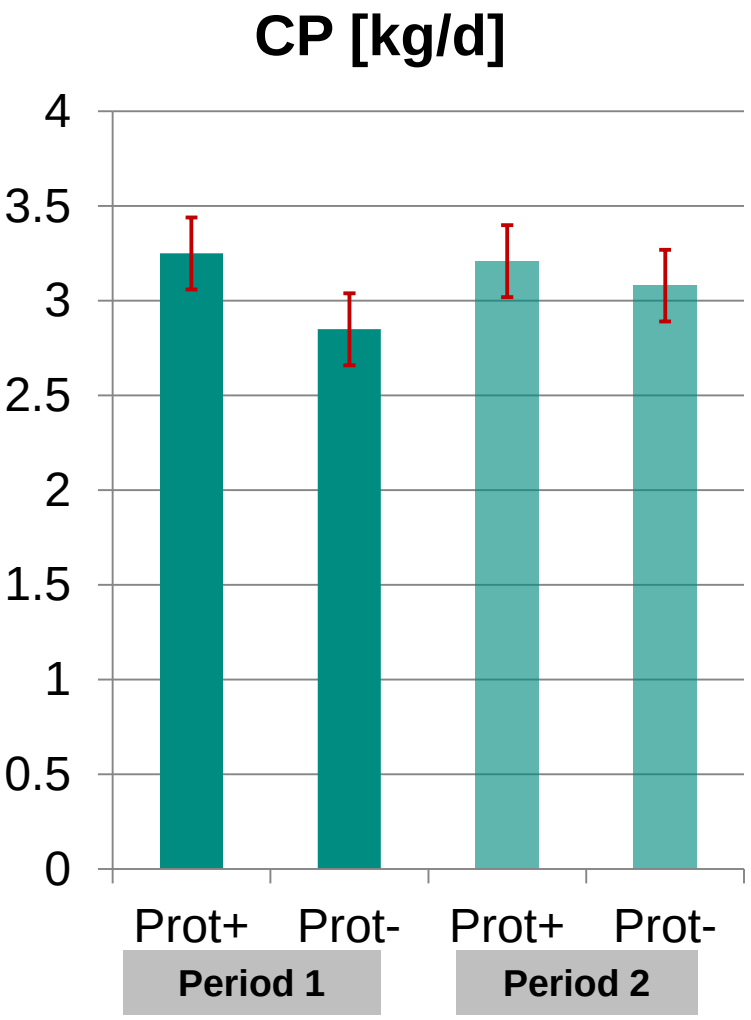
Results: rumination pattern (group Prot-)

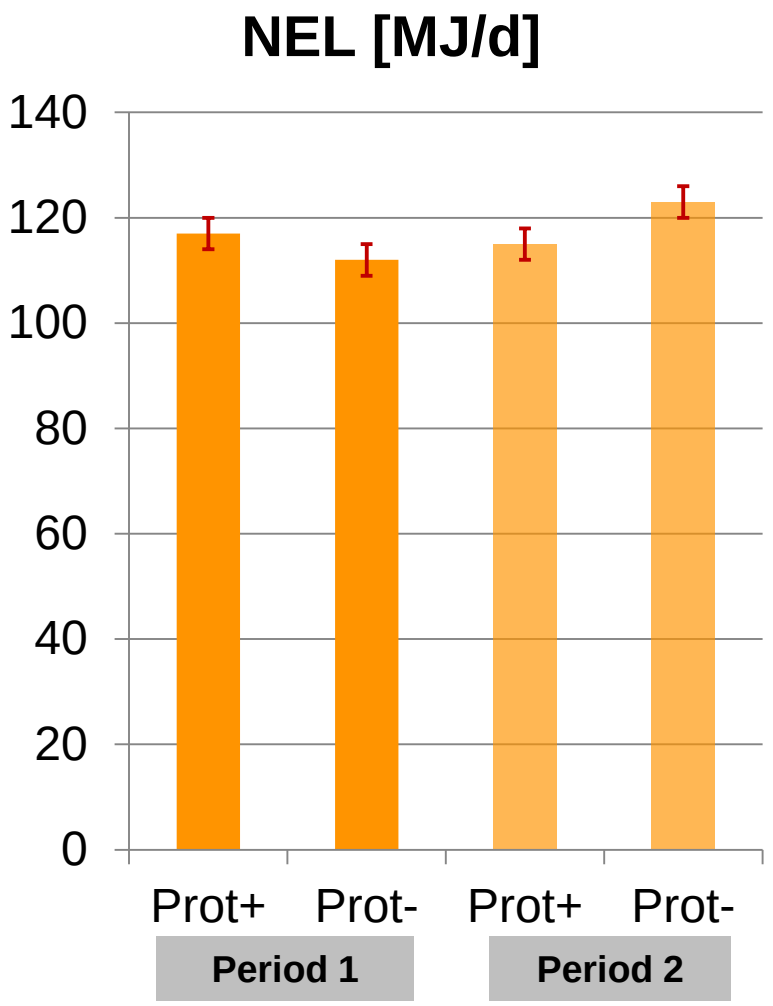


Results: Dry matter intake of cows (kg DM / d)

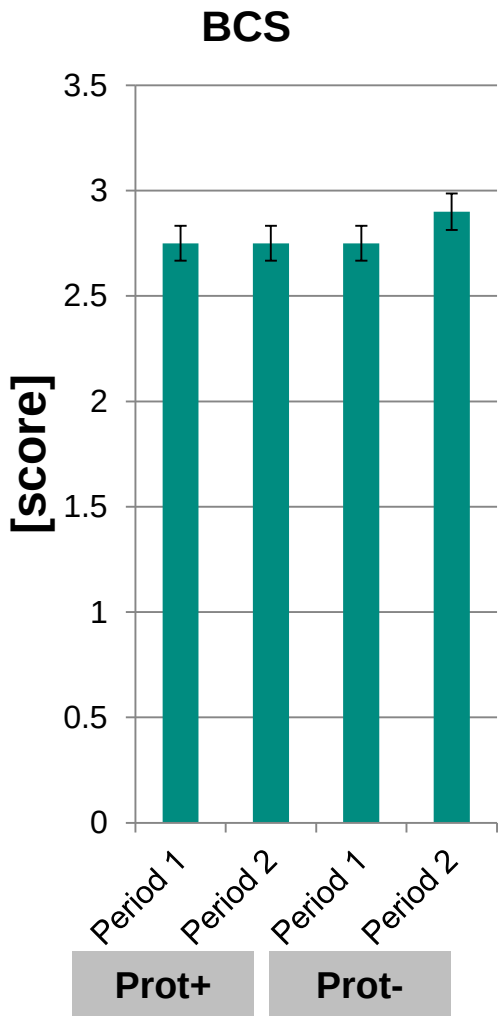


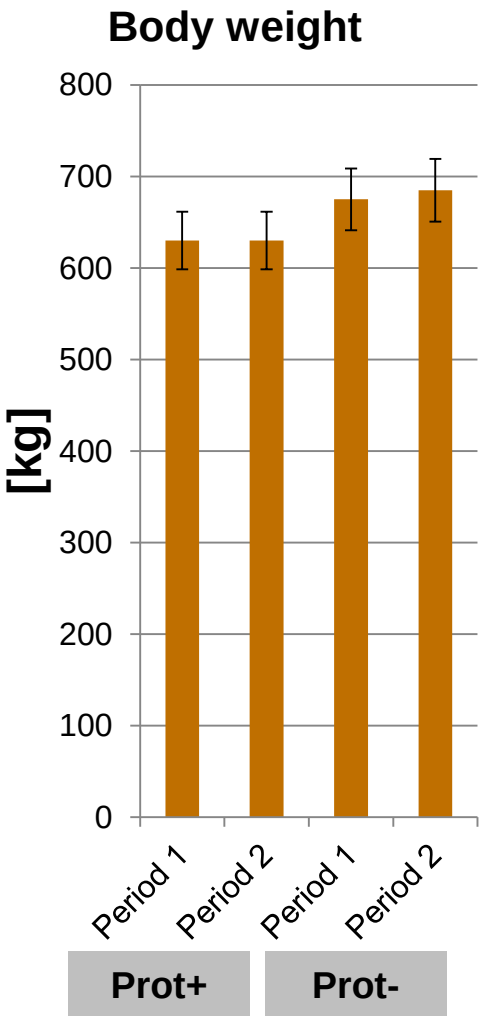
Results: Crude protein and NEL intake of cows

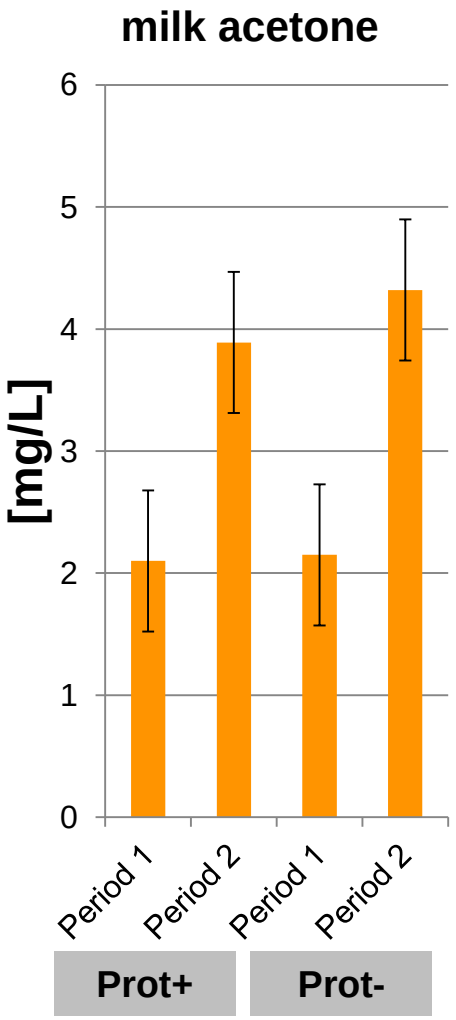




Results: BCS, body weights, milk acetone







Results: Eating time and activity changes

	Period 1		Period 2		P-values		
	Group Prot+	Group Prot–	Group Prot+	Group Prot–	Group	Period	G*P
Eating time							
Eating [min/Tag]	376	376	400	395	0,987	0,183	0,995
Eating 6–14 h [min/h]	18,4	18,5	23,2	22,2	0,718	0,001	0,640
Eating 14–22 h [min/h]	19,5	18,8	18,8	19,0	0,863	0,915	0,510
Eating 22–6 h [min/h]	9,7	10,8	8,0	8,2	0,268	0,003	0,769
Activity change							
Activity changes in 24 h [number/h]	7,86	7,76	6,35	5,94	0,764	0,027	0,830
Activity changes 6–14 h [number/h]	8,27	8,37	7,30	7,10	0,956	0,153	0,861
Activity changes 14–22 h [number/h]	8,75	8,50	7,22	6,75	0,682	0,038	0,903
Activity changes 22–6 h [number/h]	6,06	6,76	4,53	3,98	0,844	0,016	0,447

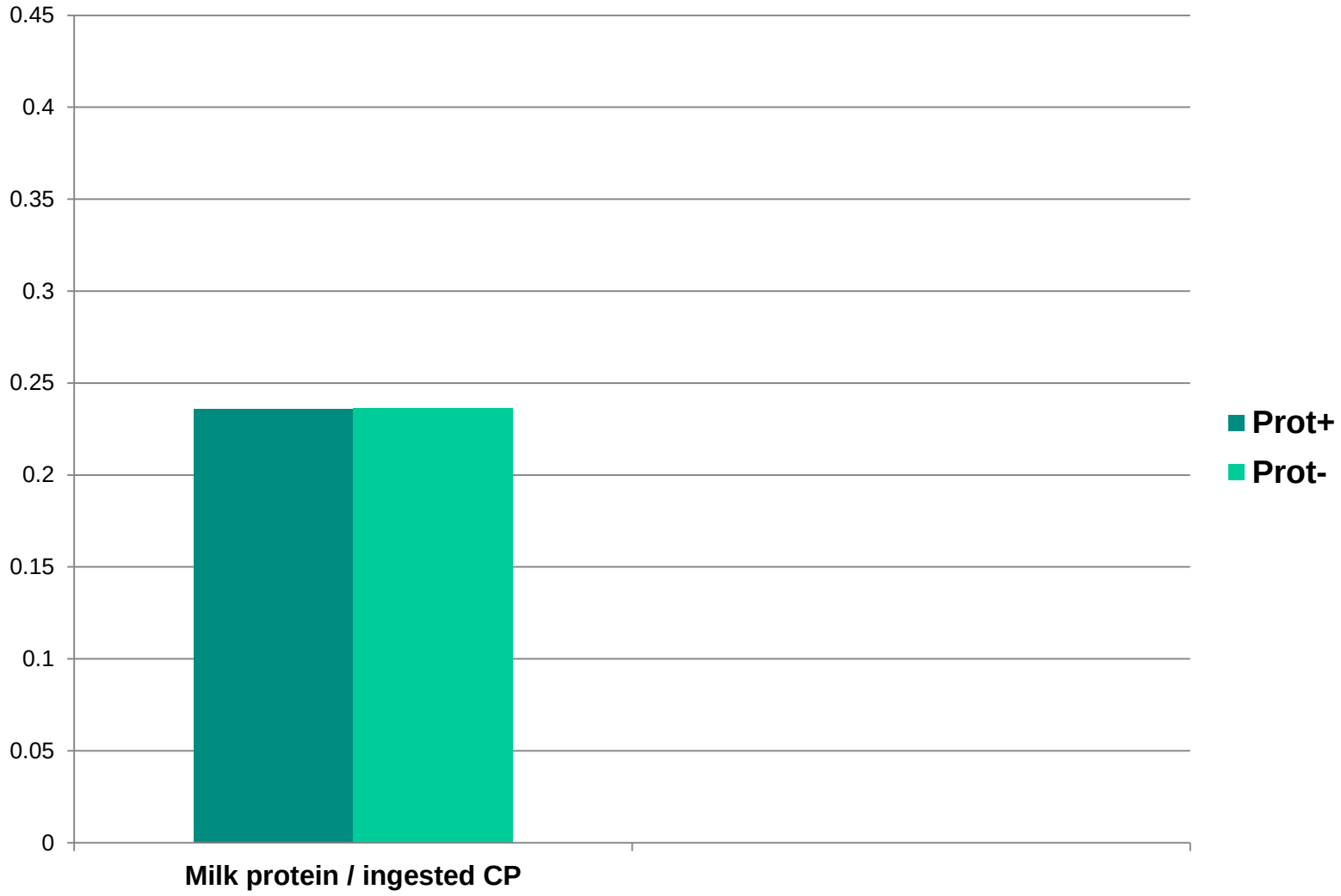
Leiber et al., 2015: *Agrarforschung Schweiz 6(10): 462-469*

Results: performance and protein efficiency

Period (P)	Period 1		Period 2		P-values		
Group (G)	Prot + (n=12)	Prot - (n=11)	Prot + (n=12)	Prot - (n=11)	G	P	G × P
Milk yield [kg/d]	24.7	21.6	23.4	19.3	<0.1	<0.05	n.s.
Milk protein concentration [g/100g]	3.09	3.20	3.22	3.34	n.s.	<0.001	n.s.
Milk fat concentration [g/100g]	3.81	4.14	3.91	4.12	n.s.	n.s.	n.s.
Milk urea concentration [mg/dl]	16.4	14.3	19.3	15.4	<0.05	<0.05	n.s.
Protein efficiency [g milk protein / g CP intake]	0.235	0.235	0.222	0.215	n.s.	<0.05	n.s.

Leiber et al., 2015, *Journal of Dairy Research* 82, 272-278

Results: protein efficiency



Conclusions I

- Sequential offer of hay in the morning significantly influenced the eating pattern, increasing intake time during daytime and decreasing intake during night time.
- Consequently the number of activity changes per hour decreased, especially during the night time.
  - We assume that this is positively related with animal welfare and health.
- Sequential offer of hay did not influence intake amounts (DM, CP, NEL)
- Concentrate reduction did not influence feeding and rumination behaviour nor milk production
- But concentrate reduction did influence roughage intake positively and promoted a higher ruminal utilisation of degraded CP in the Prot- -group (published in: Leiber et al., 2015: J. Dairy Research, 82,272-278)

Conclusions II

- Feeding and rumination behaviour parameters as measured with the noseband sensors proved to be sensitive to feeding management interventions.
- These parameters appear to be useful to assess production- and welfare-relevant responses of cows to feeding management.
- To deepen these aspects and to develop practicable tools on this basis, much broader farm-based data and experiment-based physiological research are needed.

Thank you for your time and attention!
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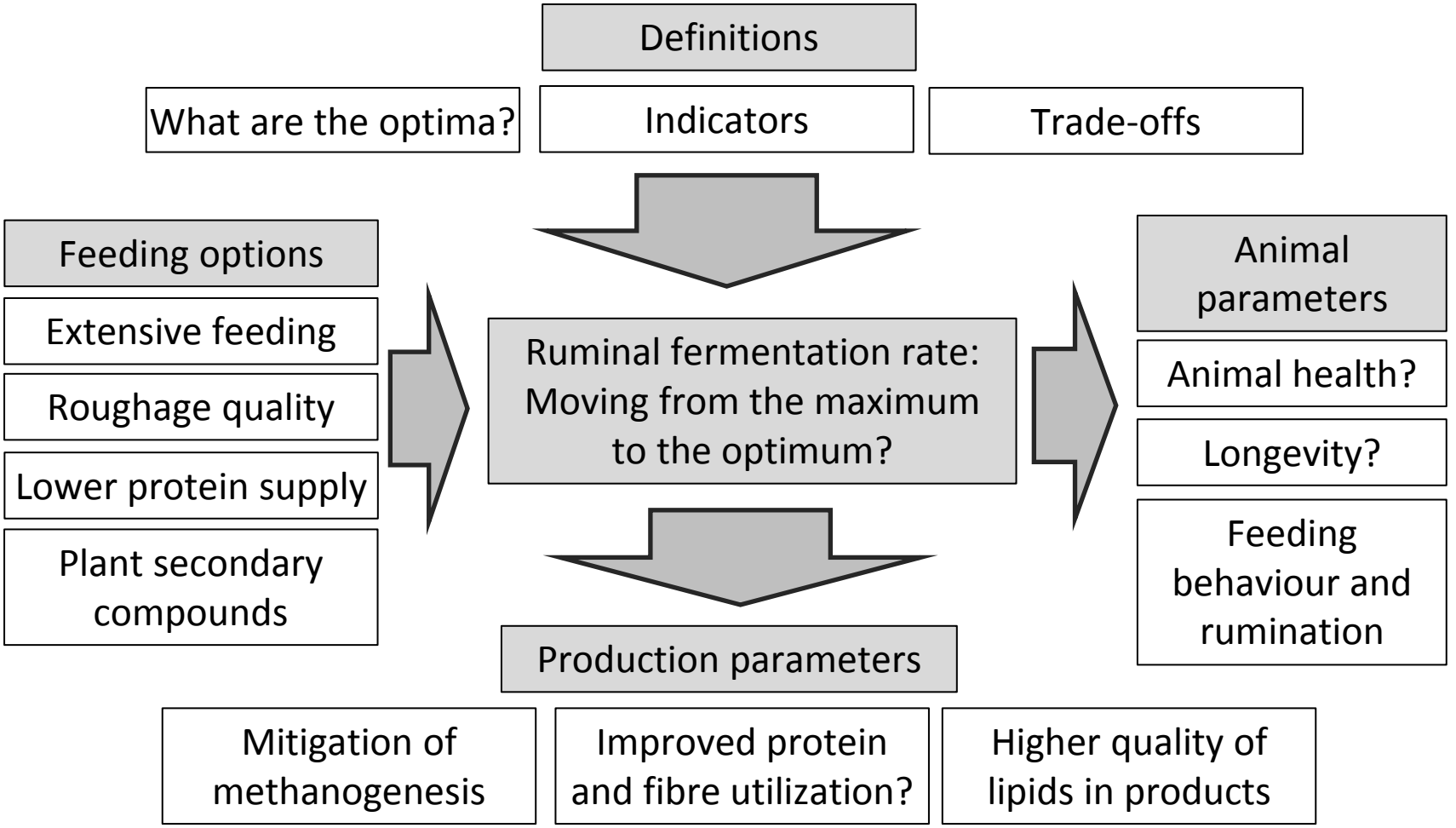
Introduction: roughage based feeding management



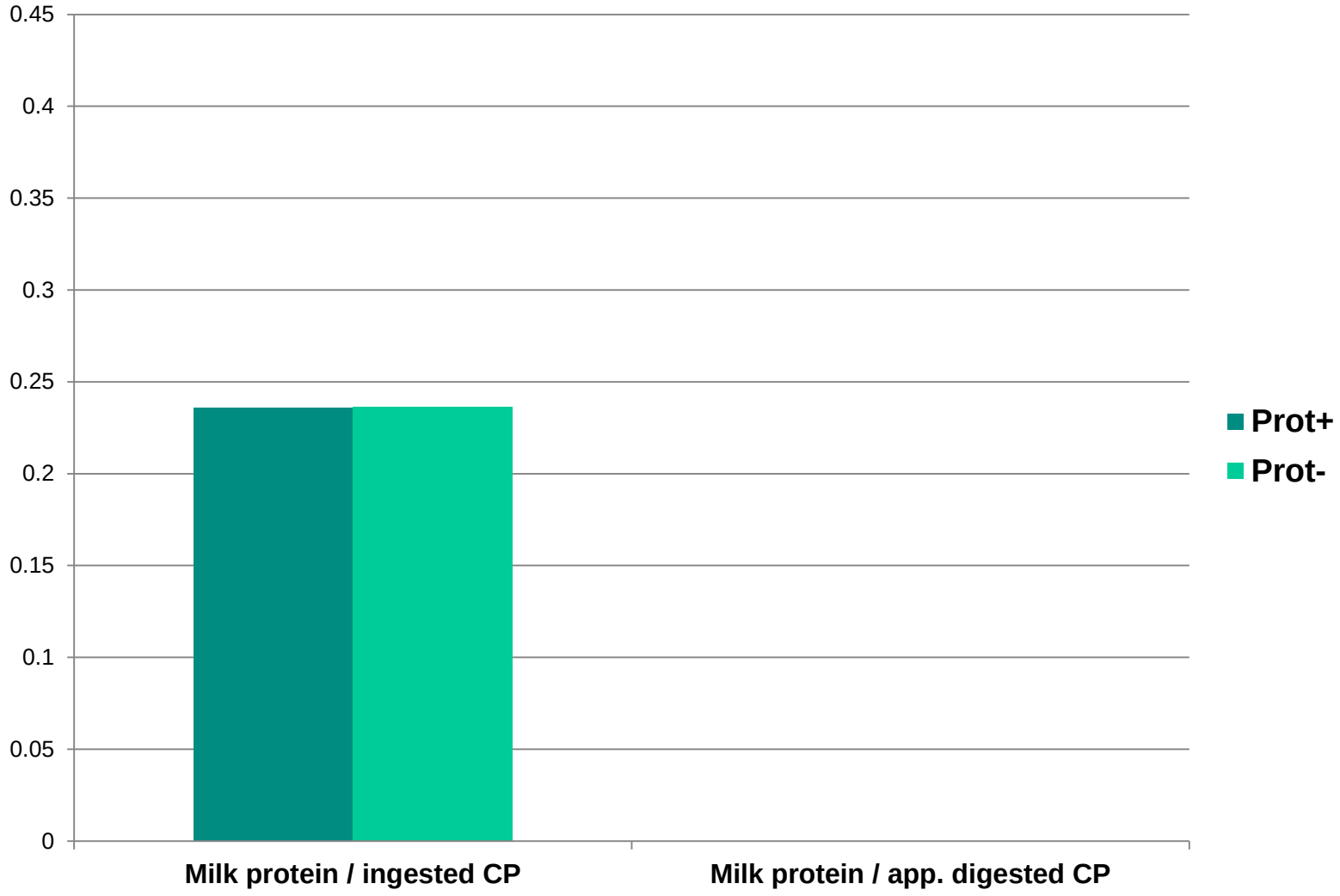
Results: intake and apparent digestibility

Period (P)	Period 1		Period 2		P-values		
Group (G)	Prot+ (n=12)	Prot- (n=11)	Prot+ (n=12)	Prot- (n=11)	G	P	G × P
Intake [kg/d]							
Total dry matter	20.5	20.4	20.0	22.0	n.s.	n.s.	n.s.
TMR	18.1	20.4	13.7	18.0	<0.05	<0.001	0.125
Concentrates	2.43	0.0	2.43	0.0	-	-	-
Extra hay	0.0	0.0	3.79	3.95	n.s.	-	-
Crude protein	3.25	2.85	3.21	3.08	n.s.	n.s.	n.s.
NEL [MJ]	117	112	115	123	n.s.	n.s.	n.s.
Apparent protein digestibility [%]	68.6	60.7	68.0	61.0	<0.001	n.s.	n.s.

Materials: diet composition

	TMR1		TMR2		Hay, 2nd cut		Concentr. 1	Concentr. 2
	Avera-ge	SD	Avera-ge	SD	Avera-ge	SD		
Crude protein [g/kg DM]	140	±4.5	133	±3.0	172	±13.0	250	380
Acid detergent fibre [g/kg DM]	298	±30	293	±0.0	335	±20.5	80.7	77.2
Lignin [g/kg DM]	41.9	±0.65	38.9	±1.35	48.0	±6.45	2.7	2.5
Crude Ash [g/kg DM]	91.6	±0.05	85.8	±0.10	90.2	±0.95	70	95
NEL [MJ/kg]	5.65	±0.05	5.70	±0.00	5.40	±0.30	7.5	7.0

Results: protein efficiency



Results: protein efficiency