



# Effect of forage type and protein supplementation on chewing and faecal particle size in sheep

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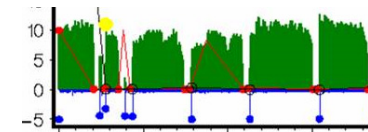
## **Introduction:** Forage characteristics

- ❑ Forage quality (Mertens, 1994,2007)
  - ❑ Characteristics:
    - ❑ Protein & starch content
    - ❑ Fibre: NDF content & lignification
    - ❑ Dig. OM
    - ❑ Fermentation characteristics/ silage addit
  - ❑ Type of forages: grass, clover, maize
  - ❑ Stage of maturity at harvest of maize



## Introduction: Effect of maturity forage<sup>EN1</sup> quality

- ❑ **Intake** of silage: D-value, NDF cont, fermentation characteris.
- ❑ **Chewing activity: ↑maturity & ↑ADF/NDF→**
  - ❑ ↑Rumination time per kg NDF: Schulze et al. 2014
  - ❑ Rumination pattern: ↑duration of ruminating cycles
  - ❑ ↑Chewing time per kg NDF



Jalali et al. 2012; Schulze et al. 2014ab

- ❑ **Faeces characteristics: ↑maturity & ↑ADF/NDF→**
  - ❑ ↑Content of DM
  - ❑ ↑Particle Dry Matter, % of DM
  - ❑ ↑Particle size

Rustas et al. 2010; Jalali et 2012a,b; Kornfelt et al. 2013a,b; Schulze et al. 2014a,b



### Dias nummer 3

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**EN1**

This is too much text. Try to get the introduction down to 1 or 1.5 slides. Only use the information that is needed for your presentation.




Elisabet Nadeau, 21/08/2014

## Objectives



- ❑ Study effect of
  - ❑ forage type, silage additive, maturity at harvest
  - ❑ protein supplementation on
- ❑ Intake, chewing activity & faeces characteristics in sheep

## Methods: design




- **Duplicated 5\*5 Latin square design**, N=50
  - 5 different forages
  - One square with & one square without **150 g rape seed meal/d**
  - 10 rams, yearlings, 75 kg BW
- **Forages:** grown at 58° 22' N, Sweden
  - **Grass-clover** silage: first cut, 20 mm TCL 
  - **Red clover** silage: first cut, 20 mm TCL 
    - With & with out: Homo/Heteroferment **Lactic Acid Bacteria**
  - **Whole crop maize silage:** 17 mm TCL 
    - Early (dough) & normal harvest(dent):

## Methods: Feeding

- **Ad libitum, +10%**, first 3 wk
- **Restrictive:** last wk
  - 80% of individual ad lib (wk 3) for 1 wk
- **Individual penning**
  - 3 first weeks: Lose 6 m<sup>2</sup> box, straw bedding.
  - Last week in metabolic boxes



## Method: Feed characteristics<sup>1</sup>

Feeds	Red clover 		Grass <sup>3</sup> 	Maize 		Rape seed meal
	LAB <sup>2</sup>	No additive		Early	Normal	
DM, %	<b>31</b> (0.9)	<b>28</b> (0.7)	<b>32</b> (1)	<b>31</b> (3)	<b>34</b> (4)	<b>89</b>
CP, % DM	<b>16</b> (0.5)	<b>17</b> (0.5)	<b>12</b> (0.1)	<b>8</b> (0.4)	<b>9</b> (0.3)	<b>35</b>
NDF, % DM	<b>47</b> (1)	<b>48</b> (1)	<b>51</b> (2)	<b>41</b> (2)	<b>41</b> (2)	<b>31</b>
ADL/NDF, g/g	<b>0.11</b>	<b>0.11</b>	<b>0.049</b>	<b>0.050</b>	<b>0.048</b>	<b>0.35</b>
Starch, % DM				<b>29</b> (6)	<b>31</b> (6)	<b>6</b>
pH	<b>4.3</b> (0.01)	<b>4.6</b> (0.09)	<b>4.1</b> (0.01)	<b>3.8</b> (0.03)	<b>3.9</b> (0.03)	
Lactic acid, %DM	<b>9.1</b> (1)	<b>6.4</b> (1)	<b>6.9</b> (0.7)	<b>5.3</b> (0.3)	<b>5.5</b> (0.5)	
Acetic acid, %DM	<b>21</b> (3)	<b>64</b> (14)	<b>17</b> (3)	<b>17</b> (4)	<b>14</b> (0.8)	
NH <sub>3</sub> -N, % total N	<b>9</b> (2)	<b>12</b> (0.4)	<b>11</b> (1)	<b>10</b> (0.5)	<b>11</b> (0.9)	

<sup>1</sup>SD in parenthesis, 5 samples

<sup>2</sup>Homo /Heterofermentative **L**actic **A**cid **B**acteria


<sup>3</sup>First cut, 77% timothy, 18% meadow fescue and 5% red clover





## Methods: Measurements




- **Ad lib intake** day 15 to 21
- **Recordings for 96 hours last week, at restrictive**
  - Collectiv forage samples each period
  - Residual feed once daily
  - Total collection of faeces
  - Chewing activity: Jaw movements oscillations (JMO)
- **Laboratory methods**
  - Washing, drying and sieving of faeces 
  - Transformation of JMO into Eating and ruminating
    - Using princip Schleisner et al. 1999.
- **Statistical analysis** : Proc mixed, SAS vers. 9.3
  - Fixed effects: forage type, period and supplement
  - Random: Animal (protein)



## Results: Ad libitum daily intake of forage DMI and NDF relative to body weight (BW)

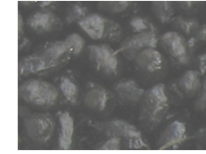


Silage	Red clover		Grass 	Maize		SEM	Effect, P<, %	
	LAB <sup>x</sup>	No additive		Early	Normal		Silage	Protein supplement
<b>DMI</b>								
%BW	2.43 <sub>a</sub>	2.38 <sub>a</sub>	2.50 <sub>a</sub>	2.16 <sub>b</sub>	2.33 <sub>ab</sub>	0.05	0.1***	0.2**
<b>NDF</b>								
%BW	1.09 <sub>b</sub>	1.11 <sub>b</sub>	1.22 <sub>a</sub>	0.84 <sub>c</sub>	0.89 <sub>c</sub>	0.02	0.1***	4*

<sup>x</sup>Homo/Heterofermentative **L**actic **A**cid **B**acteria

**NS effect of silage type or supplement on BW**





## Results: Faeces characteristics

Silage type	Red clover		Grass	Maize		SEM	Effect, P<, %
	LAB <sup>x</sup>	-		Early	Normal		
<b>DM</b> , %	40 <sub>ac</sub>	40 <sub>a</sub>	41 <sub>a</sub>	37 <sub>b</sub>	37 <sub>bc</sub>	1.5	3*
<b>PDM<sup>p</sup></b> , %	30 <sub>a</sub>	32 <sub>b</sub>	29 <sub>a</sub>	26 <sub>c</sub>	26 <sub>c</sub>	1.4	0.1**
<b>PDM</b> < 0.11 mm, %	33 <sub>a</sub>	33 <sub>a</sub>	29 <sub>b</sub>	21 <sub>c</sub>	20 <sub>c</sub>	1	0.1***
<b>PDM</b> > 1 mm, %	1.2 <sub>a</sub>	1.1 <sub>a</sub>	0.9 <sub>a</sub>	2.5 <sub>b</sub>	2.4 <sub>b</sub>	0.2	0.1***
<b>GPS<sup>G</sup></b> , mm	0.18 <sub>b</sub>	0.18 <sub>b</sub>	0.16 <sub>a</sub>	0.21 <sub>c</sub>	0.21 <sub>c</sub>	0.006	0.1***

<sup>x</sup>Homo/Heterofermentative **Lactic Acid Bacteria**

<sup>p</sup> **Particle Dry Matter**, residuals after washing, % of DM

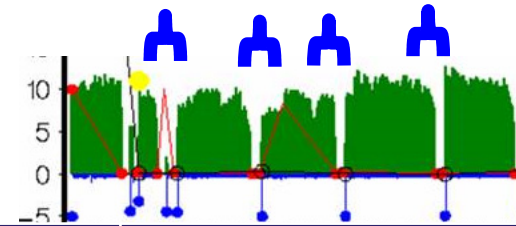
<sup>G</sup> **Geometric mean Particle Size**




**NO significant effect of protein supplement**



## Results: Effective rumination activity

Effective = Period time -  $\Sigma$  intercycle time



Silage type	Red clover 		Grass 	Maize 		SEM	Effect, P<, %	
	LAB <sup>x</sup>	No additive		Early	Normal		Silage	Protein Suppl.
Min per day	423 <sub>a</sub>	454 <sub>a</sub>	377 <sub>b</sub>	459 <sub>b</sub>	450 <sub>b</sub>	16	0.1 <sup>***</sup>	NS
JM per g NDF	70 <sub>a</sub>	70 <sub>a</sub>	56 <sub>b</sub>	95 <sub>c</sub>	92 <sub>c</sub>	3.7	0.1 <sup>***</sup>	NS
Min per kg NDF	706 <sub>a</sub>	692 <sub>a</sub>	554 <sub>b</sub>	932 <sub>c</sub>	918 <sub>c</sub>	25	0.1 <sup>***</sup>	NS
<b>Ruminating cycles (RC)</b>								
RC per g NDF	1.1 <sub>a</sub>	1.0 <sub>b</sub>	1.0 <sub>b</sub>	1.3 <sub>c</sub>	1.3 <sub>c</sub>	0.05	0.1 <sup>***</sup>	4*
Sec per RC	40 <sub>a</sub>	40 <sub>ac</sub>	35 <sub>b</sub>	43 <sub>c</sub>	42 <sub>c</sub>	1.4	0.1 <sup>***</sup>	6
JM per RC	66 <sub>a</sub>	68 <sub>ac</sub>	59 <sub>b</sub>	72 <sub>c</sub>	70 <sub>c</sub>	2.2	0.1 <sup>***</sup>	7

<sup>x</sup>Homo/Heterofermentative **L**actic **A**cid **B**acteria

### Effect of protein supplementation

- 0.2 RC per gNDF, P<4%, intake of NDF as covariate ->only significant effect of NDFI



## Results: Effective Eating and total activity

	Eating	Total chewing = Eating+ruminating
Min effective per day	157	588
JM per g NDF	24	100
Min effective per kg NDF	280	1040

NS effect of silage type or protein supplement on Eating and total chewing activity



## Conclusions

- **Forage type affects**
  - Intake of DM and NDF
  - Rumination activity: min/kg NDF and pattern
  - Faeces characteristics: particle size & particle DM
- **Silage additive (LAB)**
  - ↑ Ruminating cycles per g NDF
  - ↓ Particle DM in faeces, % DM
- **No effects of early vs normal harvest maize**
- **Protein supplement**
  - ↑ intake of DM and NDF
  - ↔ chewing and faeces characteristics
- **No effect of forage type or supplement on**
  - Eating and total chewing activity





Extra slides for answering questions:

$$\text{GPS} = \exp \left( \begin{array}{l} [A \times \ln(0.05)] + [B \times \ln \sqrt{(0.106 \times 0.212)}] + [C \times \ln \sqrt{(0.212 \times 0.5)}] \\ + [D \times \ln \sqrt{(0.5 \times 1.0)}] + [E \times \ln \sqrt{(1.0 \times 2.36)}] + [F \times \ln \sqrt{(2.36 \times 4.75)}] \end{array} \right),$$





# Methods: Preparation of digesta

1. **Washing in 2-3 nylon bags:**
  - 10  $\mu\text{m}$  pore size
  - 1-2 g dry matter per bag
  - 2 ml liquid soap per g dry matter
  - Washing machine: colour at 40°C
2. **Freeze drying:**
3. **Dry sieving though**
  - 2.36, 1.0, 0.5 & 0.2 mm pore size
  - Weighing sieve fractions->
  - Mass proportions

