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

EAAP annual Meeting August 28, 2014, session 49

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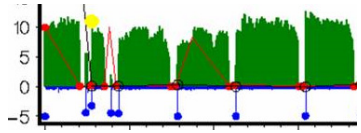
Introduction: Forage characteristics

- 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 quality EN1

- **Intake** of silage: D-value, NDF cont, fermenation 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

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 58^0 22’ N, Sweden
  - **Grass-clover** silage: first cut, 20 mm TCL 
  - **Red clover** silage: first cut, 20 mm TCL 
    - With & with out: Homo/Heteroferment **L**actic **A**cid **B**acteria
  - **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^2 box, straw beeding.
  - Last week in metabolic boxes

Method: Feed characteristics[1]

Feeds	Red clover 		Grass[3] 	Maize 		Rape seed meal
	LAB[2]	No additive		Early	Normal	
DM,%	**31**(0.9)	**28**(0.7)	**32**(1)	**31**(3)	**34** (4)	**89**
CP,% DM	**16**(0.5)	**17**(0.5)	**12**(0.1)	**8** (0.4)	**9**(0.3)	**35**
NDF,% DM	**47**(1)	**48**(1)	**51**(2)	**41**(2)	**41**(2)	**31**
ADL/NDF, g/g	**0.11**	**0.11**	**0.049**	**0.050**	**0.048**	**0.35**
Starch, % DM				**29** (6)	**31** (6)	**6**
pH	**4.3**(0.01)	**4.6**(0.09)	**4.1**(0.01)	**3.8**(0.03)	**3.9**(0.03)	
Lactic acid,%DM	**9.1**(1)	**6.4**(1)	**6.9**(0.7)	**5.3**(0.3)	**5.5**(0.5)	
Acetic acid,%DM	**21**(3)	**64**(14)	**17**(3)	**17**(4)	**14**(0.8)	
NH_3-N, % total N	**9**(2)	**12**(0.4)	**11**(1)	**10**(0.5)	**11**(0.9)	

[1]SD in parenthesis, 5 samples
[2]Homo /Heterofermentative **L**actic **A**cid **B**acteria
[3]First cut, 77% timothy, 18% meadow fescue and 5% red clover

Methods: Measurements

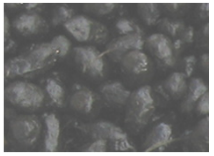
- **Ad lib intake** day 15 to 21
- **Recordings for 96 hours last week, at restrictive**
  - Collectiv forage samples each period
  - Residual feed once daily
  - Total collection of faeces
  - Chewing activity: Jaw movements oscillations (JMO)
- **Laboratory methods**
  - Washing, drying and sieving 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 weigth (BW)

Silage	Red clover		Grass	Maize		SEM	Effect, P<,%	
	LAB[x]	No additive		Early	Normal		Silage	Protein supplement
DMI								
%BW	2.43_a	2.38_a	2.50_a	2.16_b	2.33_{ab}	0.05	0.1***	0.2**
NDF								
%BW	1.09_b	1.11_b	1.22_a	0.84_c	0.89_c	0.02	0.1***	4*

[x]Homo/Heterofermentative **L**actic **A**cid **B**acteria

NS effect of silage type or supplement on BW




Results: Faeces characteristics

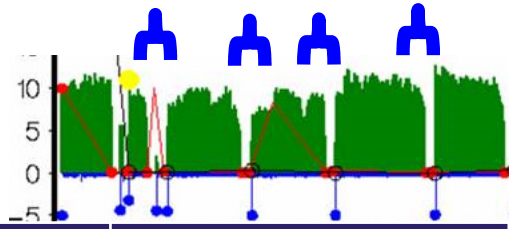
Sliage type	Red clover 		Grass 	Maize 		SEM	Effect, P<,%
	LAB[x]	-		Early	Normal		Silage
DM,%	40_{ac}	40_{a}	41_{a}	37_{b}	37_{bc}	1.5	3*
PDM[p], %	30_{a}	32_{b}	29_{a}	26_{c}	26_{c}	1.4	0.1**
PDM<0.11m %	33_{a}	33_{a}	29_{b}	21_{c}	20_{c}	1	0.1***
PDM>1 mm ,%	1.2_{a}	1.1_{a}	0.9_{a}	2.5_{b}	2.4_{b}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

[x]Homo/Heterofermentative **L**actic **A**cid **B**acteria
[P] **P**article **D**ry **M**atter, residuals after washing, % of DM
[G] **G**eometric mean **P**article **S**ize

NO significant effect of protein supplement

Results: Effective rumination activity

Effective= Period time - Σ intercycle time



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

[x]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 addifive (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:

$$GPS=\exp\left(\begin{array}{l}\left[A\times\ln(0.05)\right]+\left[B\times\ln\sqrt{(0.106\times0.212)}\right]+\left[C\times\ln\sqrt{(0.212\times0.5)}\right]\\+\left[D\times\ln\sqrt{(0.5\times1.0)}\right]+\left[E\times\ln\sqrt{(1.0\times2.36)}\right]+\left[F\times\ln\sqrt{(2.36\times4.75)}\right]\end{array}\right),$$

Methods: Preparation of digesta

1. Washing in 2-3 nylon bags:
   - 10 μm 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

Nørgaard et al. 2004