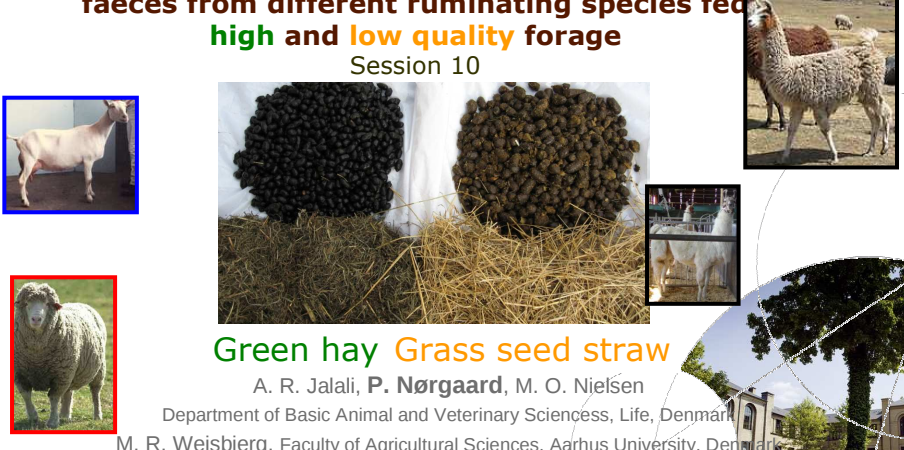


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Faculty of Life Sciences

Effect of feed quality on particle size in faeces from different ruminating species fed high and low quality forage
Session 10



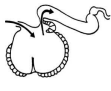
Green hay Grass seed straw

A. R. Jalali, P. Nørgaard, M. O. Nielsen
Department of Basic Animal and Veterinary Sciences, Life, Denmark
M. R. Weisbjerg, Faculty of Agricultural Sciences, Aarhus University, Denmark

P. Nørgaard, Nordic Forage Network- Workshop-Umeå 22/5-2007
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Introduction

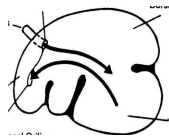



1. Llamas, sheep and goats are ruminating species and are foregut fermenting herbivores.
2. Sheep and goats are ruminants with a four stomach digestive system. Llamas are Camelids, which have a three stomach digestive system (Lechner-Doll et al. 1991).
3. There is a selective retention of large particles in the rumen (Kennedy, 1985), a but little is know about the llamas.
4. The natural diets for llamas, sheep and goats is grass, but the llamas are less domesticated and are adapted to a poor quality grass diet.
5. The size dimension of faeces particles has been analysed by sieving techniques (Waldo et al. 1971) and by image analysis (Nørgaard, 2006).
6. The mean size of faeces particles increases with increasing body weight and is larger in non ruminant foregut fermentors compared with ruminants (Fritz et al. 2009)
7. The arithmetic mean size of faeces particles from ruminants ranges between 0.2 to 0.3 mm, and the mean length is around 1-2 mm.
8. The most frequent size of faeces particles has been shown to increase due to late harvest and high lignifications of forages (Nørgaard & Kornfelt, 2006; Jalali et al. 2008)

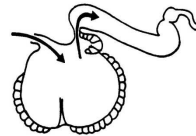
Objective

- Was to compare particle size distribution in faeces from different small ruminating species fed **high** or **low** quality forage

Ruminants



Camelids



Method: design

Crossover block design: **3 species** & **2 treatments**

Species: 6 mature females

- Shropshire sheep, BW= 75 kg
- Danish Landrace goat, BW=45 kg
- Kh'aras breed, Lama glama, BW= 135 kg



Treatments:

Green hay (GH), chopped, fed ad libitum

Grass seed straw (GSS), Red fescue, fed ad libitum



Recordings:

Intake over 4 days

Total collection of faeces over 4 days

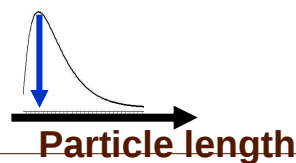
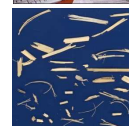


Method: Forage characteristics (% of DM)

	Chopped Green Hay	Grass seed straw
		
Crude protein	15	7
NDF	58	81
ADL/NDF ,%	6.9	9.9

**Method: Measurement of particle size in faeces**

1. 10 g faeces were washed and dried
2. Dry sieving into 6 different fractions: 2.36, 1, 0.5, 0.2 and 0.1 mm pores size & a bottom bowl
3. The arithmetic and geometric mean particle sizes (Waldo *et al.* 1971) and the mode particle size (Nørgaard, 2006) were calculated
4. Sub-samples from each fraction were scanned
5. Individual particles were identified and their area, length and width were measured by image analysis
6. Distribution of particle length & width by gamma distribution functions for the individual sieving fractions, overall distribution as composite function (Nørgaard, 2006)



Statistical analysis

Proc. mixed, SAS (ver. 9.2),
N=36 observations:

Model:

$$Y_{ijk} = \mu + \alpha(\text{species}_i) + \beta(\text{forage}_j) + \gamma(\text{period}_k) + \lambda(\text{species}_i \times \text{forage}_j) + e_{ijk}$$

Random: Replications within each treatment (n=3)



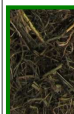
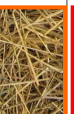
Results



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Daily intake of DM and NDF							
	Sheep		Goat		Llama		Difference, P<
							Forage type Species F x S
g DM/kg BW^{0.75}							NS
- Green hay	44		40		44		
- Grass seed straw	51 ^a		34 ^{ab}		26 ^b		
NDF/BW, %							0.01
- Green hay	0.91		0.89		0.73		
- Grass seed straw	1.4		1.3		0.6		

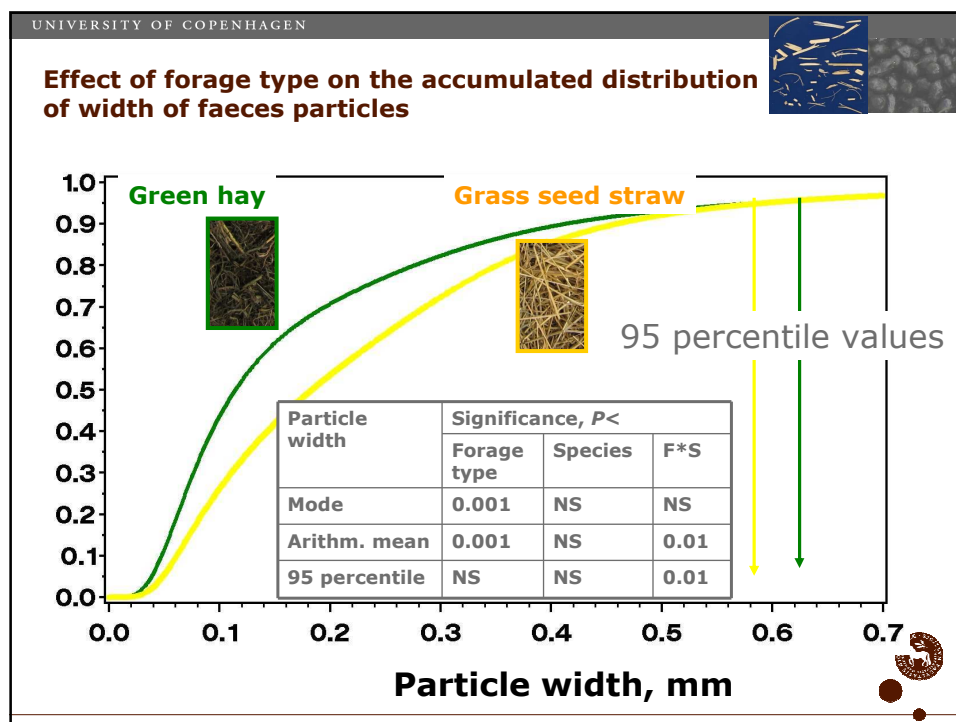
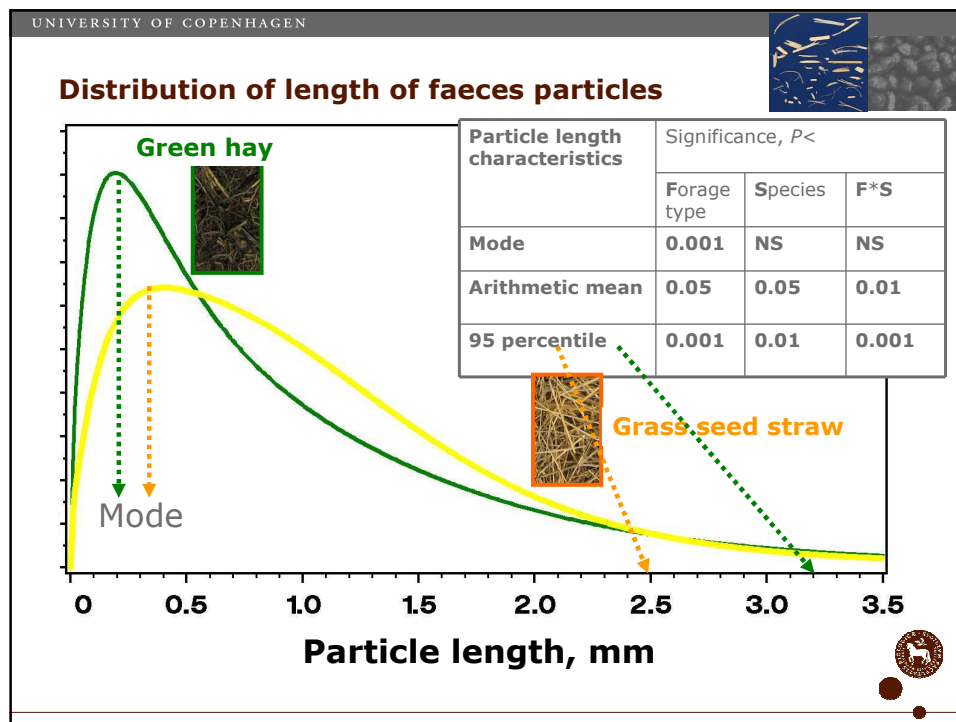
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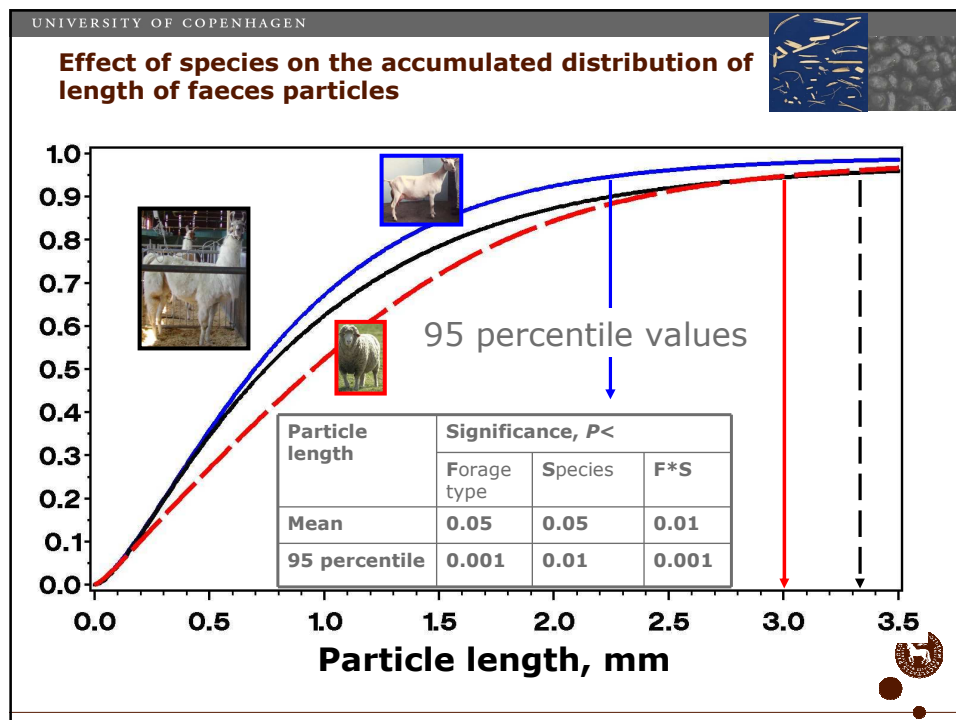
Size of faeces particles measured by sieving

	Forage type		Species			SEM	Significance	
	GH	GSS	Sheep	Goat	Llama		Forage type	Species
								
Mode_PS, mm	0.18	0.22	0.23 ^a	0.20 ^b	0.17 ^c	0.008	0.001	0.001
Geometric mean, mm	0.17	0.18	0.19 ^a	0.16 ^b	0.16 ^a	0.005	T	0.001
Arithmetic mean, mm	0.24	0.24	0.26 ^a	0.21 ^b	0.24 ^a	0.006	NS	0.01
<0.1 mm, %	25	21	18 ^c	24 ^b	26 ^a	0.9	0.001	0.001
> 1.0 mm, %	1.8	0.9	1.3 ^a	0.6 ^b	2.2 ^a	0.25	0.01	0.001

Significant ($P < 0.05$) interaction between forage type and species

Significant (P<0.05) interaction between forage type and species





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Conclusions and implications

1. The ad libitum intake of NDF,% BW, was 50% higher with feeding **grass seed straw**, but the intake by llamas was only ½ compared with sheep and goats.
2. Feeding highly lignified NDF from poor quality forage like **grass seed straw** leads to less small faeces particles, but also to less large particles compared with feeding high quality forage diets.
3. The size of faeces particles from goats measured by sieving technique were generally smallest, whereas llamas fed **Green hay** had more large particles.
4. The distribution of faeces particles is affected by both forage quality and type of ruminating species.
5. Camelids like llamas appear to be have a less effective selective retention of large particles of **green hay** in the fore stomach compared with ruminants.