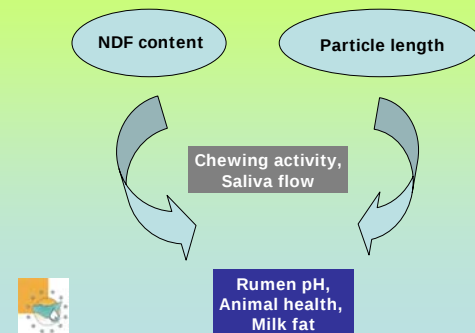


Determination of feed particle size reduction by chewing using an image analysis procedure

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Introduction:



Introduction:

Mertens (1997)

-**peNDF** is related to physical characteristics of fiber (primarily particle size) that influence chewing activity

-**peNDF** = NDF * % residue on a 1.18mm screen (vertical sieving)



fecal particles are supposed to pass the 1.18mm screen.

Introduction and Objective:

Only few studies actually measured particle size reduction during initial mastication.

In all of these studies sieving techniques are used.



To examine the long particle distribution in a swallowed bolus from hay of variable lengths using image analysis.

Materials and methods:

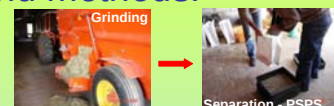
Treatments:

Loietto grass hay cut at 6 different chop lengths



Materials and methods:

Treatments:



Materials and methods:

Treatments:



Materials and methods:

Animals:

- 3 nonlactating.

rumen fistulated cows

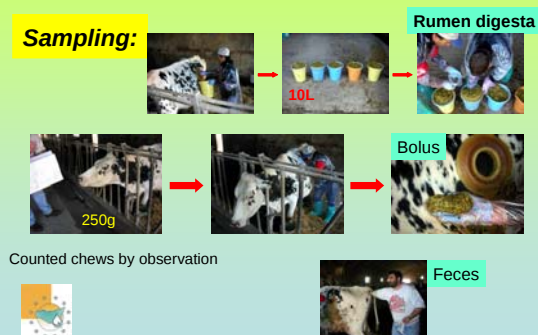


- adapted to Loietto grass hay for 7 days before sampling

- feed with held for 12 hours before sampling

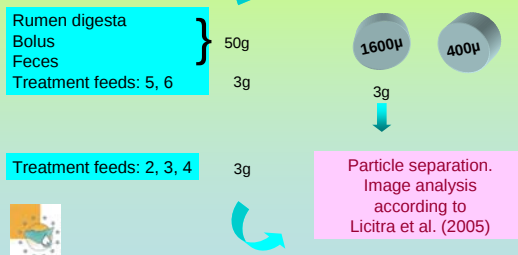
Materials and methods:

Sampling:



Materials and methods:

Analysis:



Materials and methods:

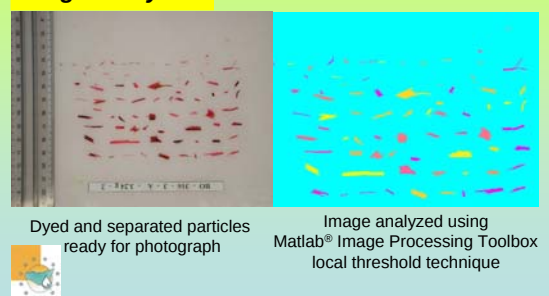
Preparation for Image Analysis:

- Sample soaked in acetone, NDF solution, tert-butanol
- Dyed with safranin
- Particles separated and distributed for image analysis



Materials and methods:

Image Analysis:



Materials and methods:

Analysis of particle distribution:

-Mean size calculation.

1. excluded Matlab counted particles < 5mm primarily artifacts from image reflectance less than peNDF by definition

2. Kaplan-Meir method to analyze mean length

-Chemical analyses of treatment feeds:
DM, Ash, CP, NDF



Results:

Chemical composition of feeds:

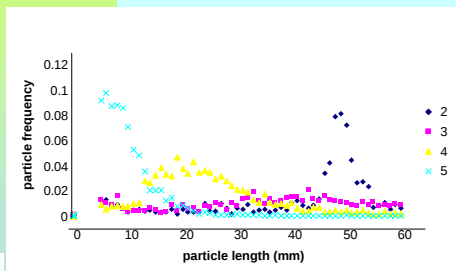
Treatm.	DM	Ash	CP	NDF
1	90.7 ^a	9.5 ^b	10.3 ^d	65.1 ^{a,b}
2	90.7 ^a	10.0 ^b	11.0 ^{c,d}	68.3 ^a
3	90.1 ^{ab}	10.2 ^b	11.3 ^{c,d}	66.6 ^a
4	89.8 ^{ab}	9.8 ^b	11.4 ^c	65.9 ^{a,b}
5	89.6 ^b	9.5 ^b	13.7 ^b	62.5 ^b
6	89.6 ^b	13.1 ^a	16.4 ^a	48.4 ^c

p<0.05



Results:

HAY – Particle distribution



Results: HAY – Particle mean size

Treatment	Mean size (mm)
1 long	600*
2 50mm	46.2 ^b
3 > 19.1mm	51.0 ^a
4 7.9 - 19.1mm	25.8 ^c
5 1.3 - 7.9mm	9.8 ^d

*estimated maximum length

p<0.05



Results:

Presieving - BOLUS :

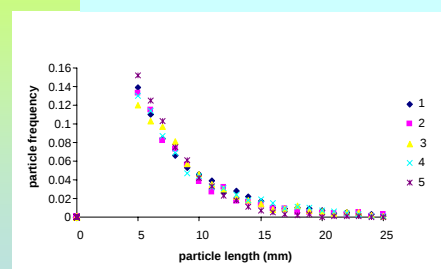
Treatm.	Bolus dry residues (%)		
	1600μ	400μ	smaller
1	62.7 ^a	15.5 ^c	21.8 ^c
2	51.5 ^b	20.3 ^b	28.2 ^b
3	60.5 ^a	14.6 ^c	24.9 ^{b,c}
4	65.2 ^a	12.9 ^c	21.9 ^c
5	57.8 ^{a,b}	15.4 ^c	26.8 ^{b,c}
6	10.8 ^c	39.8 ^a	49.4 ^a

p<0.05



Results:

BOLUS – Particle distribution



Results: **BOLUS – Particle mean size**

Treatment	Mean size (mm)
1 long	9.1 ^{a,b}
2 50mm	9.1 ^{a,b}
3 > 19.1mm	9.5 ^a
4 7.9 - 19.1mm	9.0 ^b
5 1.3 - 7.9mm	7.8 ^c

p<0.05



Results: **Treatment 6: Presieving**



Hay dry residues (%)				Mean Rumen digesta dry residues (%)		
Treatm.	1600μ	400μ	smaller	1600μ	400μ	smaller
6	33.1	34.2	32.6	24.1	37.7	38.3

Bolus dry residues (%)				Feces dry residues (%)		
Treatm.	1600μ	400μ	smaller	1600μ	400μ	smaller
6	10.8	39.8	49.4	11.9	34.1	54.0

p<0.05



Results: **Cow difference**

Cow	Chews/ g feed	Mean particle size (mm)		
		Bolus	Rumen digesta	Feces
A	1.07 ^b	9.9 ^a	8.3 ^a	7.3 ^a
B	1.22 ^b	8.8 ^b	7.9 ^b	7.0 ^a
C	2.28 ^a	8.3 ^c	7.9 ^b	7.0 ^a

p<0.05



Conclusions:

-All hay particles retained on a 8mm screen (mean size >25.8mm) had the same particle distribution and mean size in the bolus.
NO EFFECT OF INITIAL PARTICLE SIZE ON BOLUS PARTICLE SIZE

-Hay particles of a smaller mean size (passed through the 8 mm screen) had smaller boli particles



Conclusions:

- Feed particles ≥ 2.5 cm appear to be 100% chewing effective.
- Feed particles retained on a 1.18 mm screen are chewed, but do not appear to be peNDF
- The "Breaking point" of 100% effectiveness of feed particles is probably between 1 cm and 2.5 cm.



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