
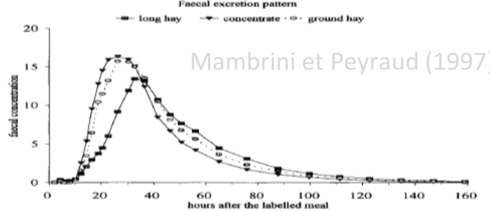

Size and density influence of concentrates to increase by-pass protein fraction in dairy cows' diet

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  - Reduce the use of vegetable proteins (increase protein efficiency)
  - Reduce nitrogen excretion in environment

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    - New protections (essential oils, vegetable tannins)
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      - Short-term action

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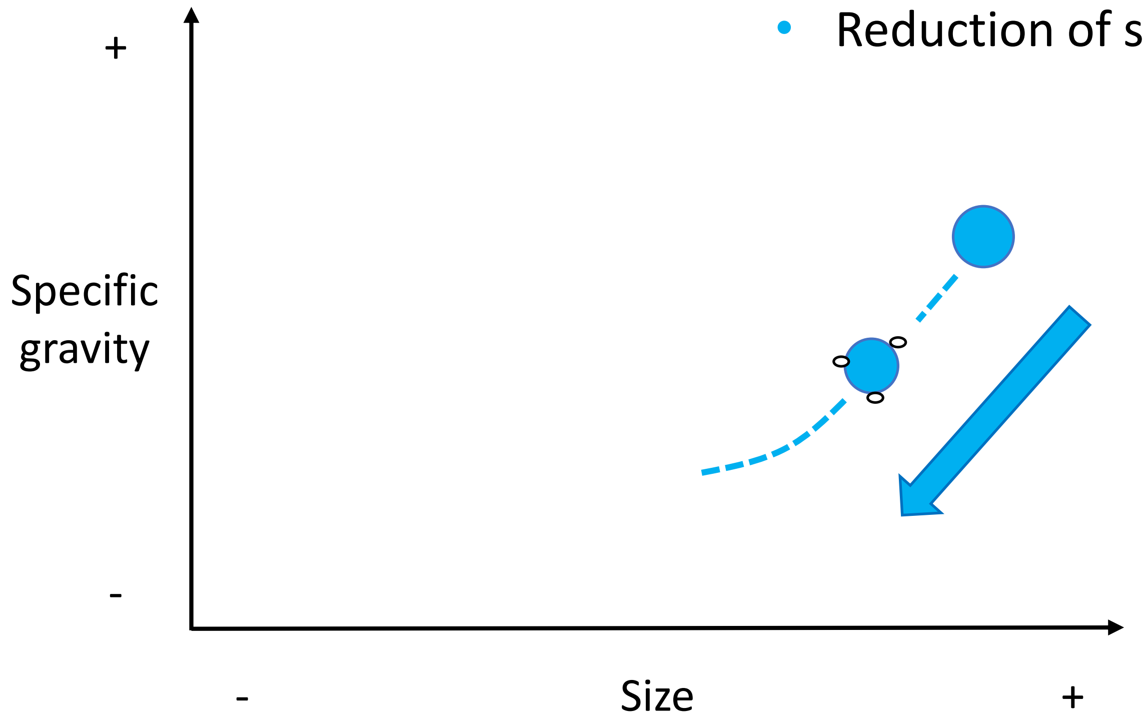

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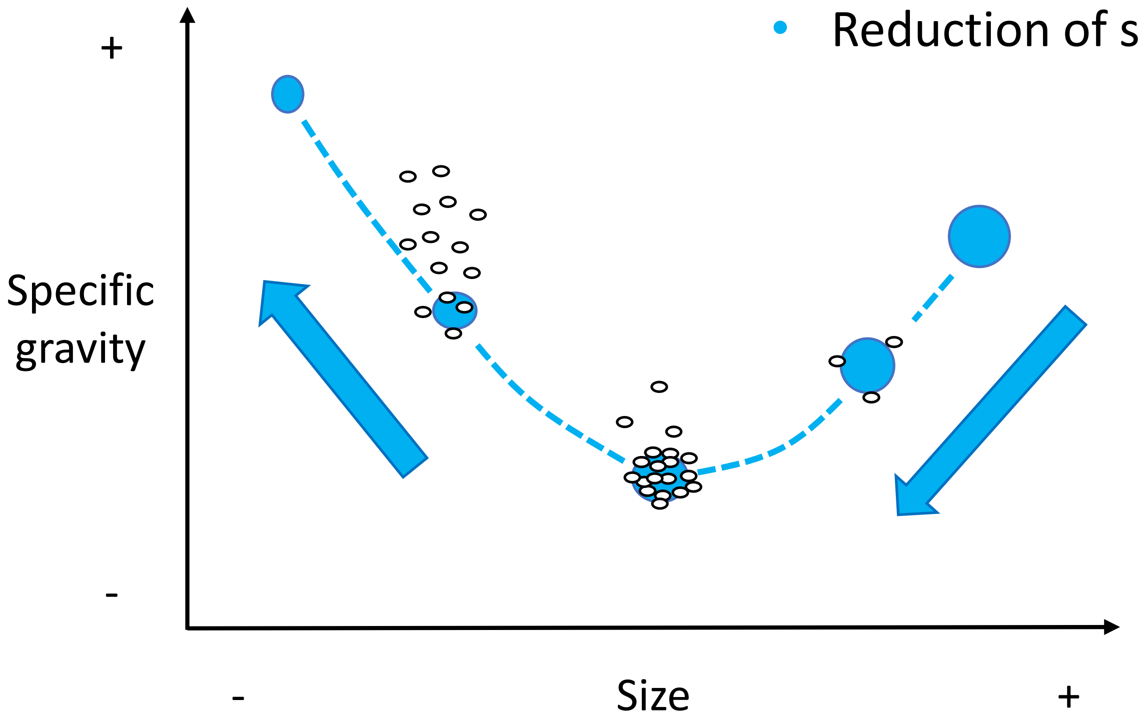

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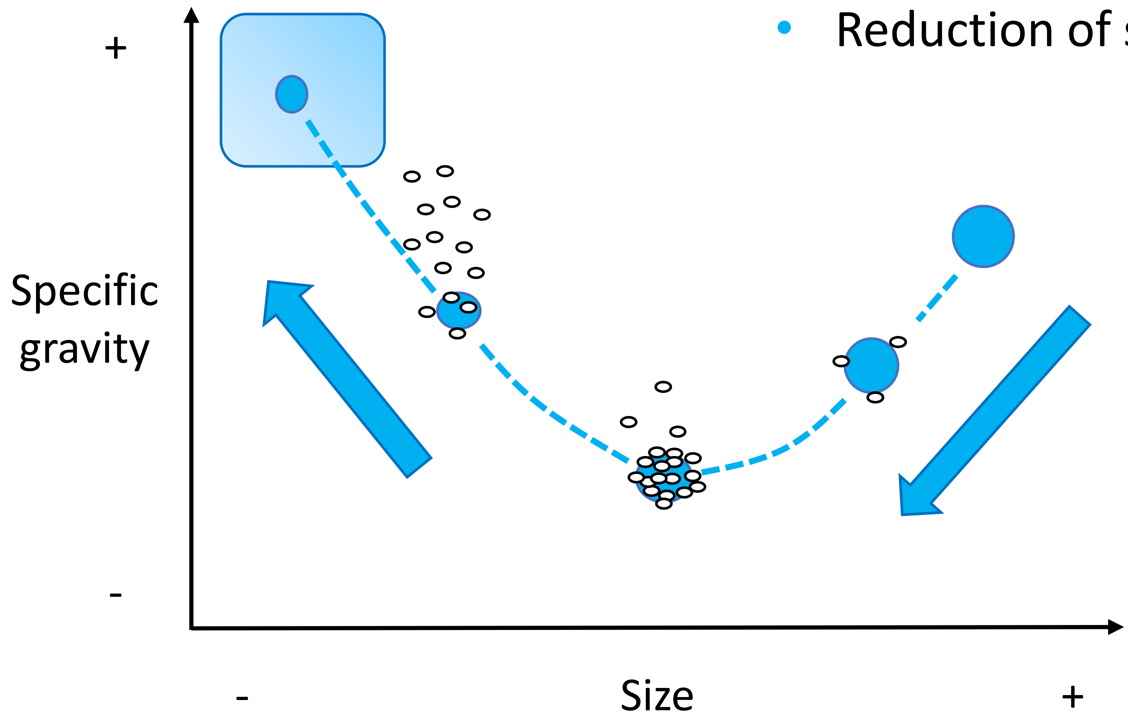

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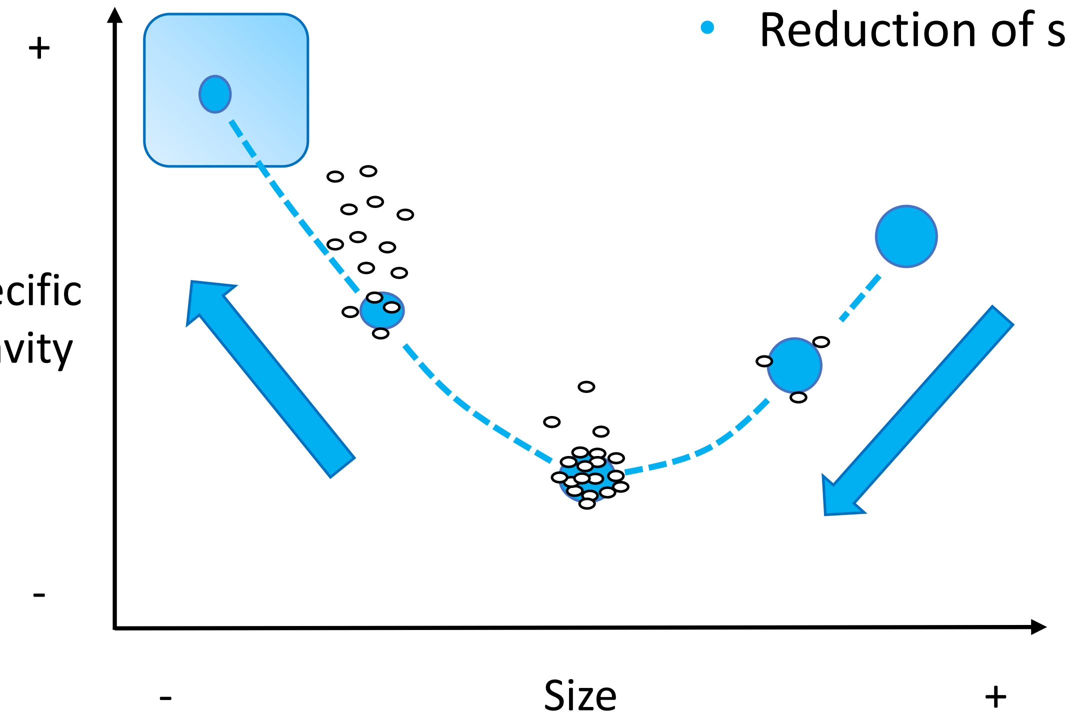

➢ Effects of size and density on particle passage rate in the rumen
- Known on forages
- Few studies on concentrates

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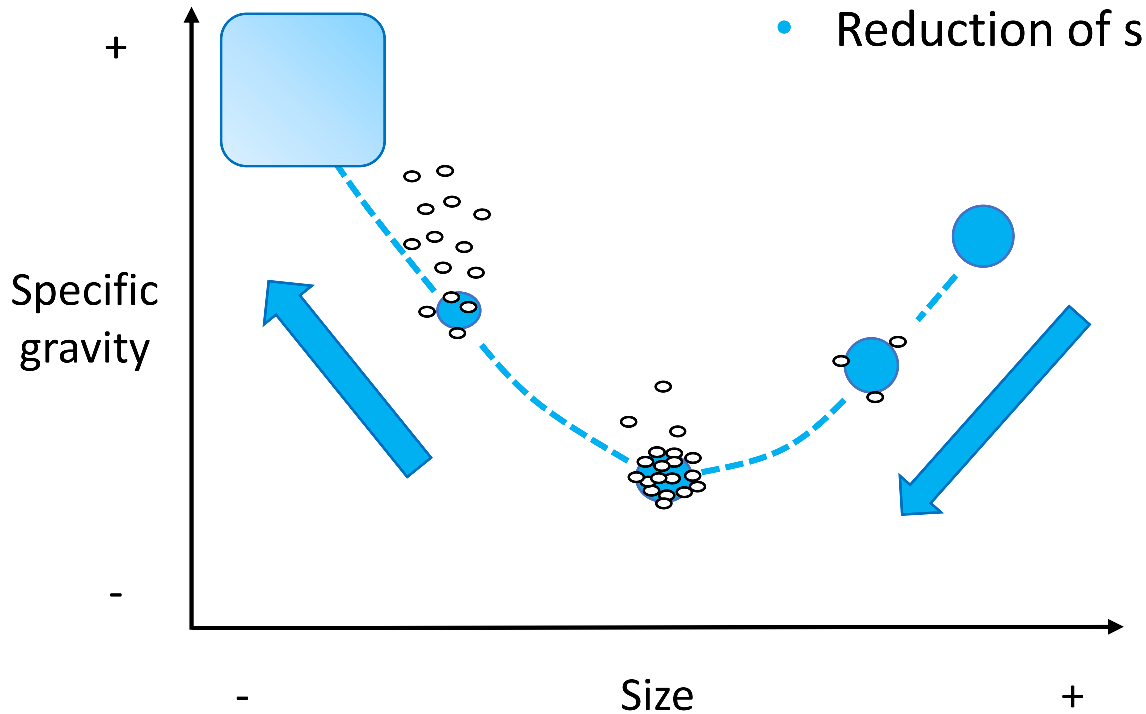
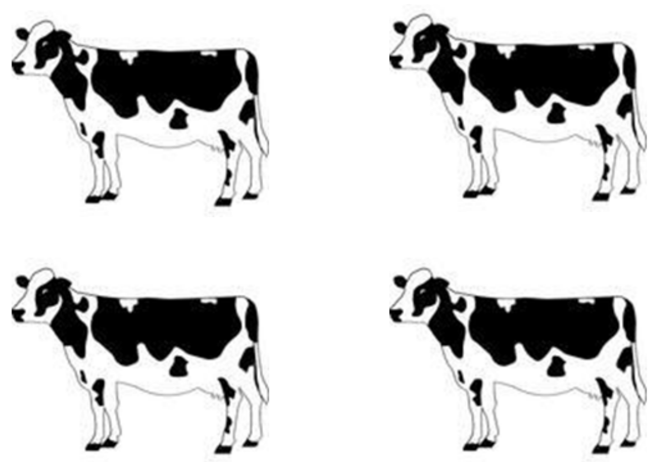


Which size and density of concentrates allow the fastest escape from the rumen ?

- Use of plastic particles:
  no effect of rumen microbial fermentations

- Experimental design:
  4 lactating cows in a Latin square design

T: 0.5 mm
d: 0.9 – 1.1 – 1.3 – 1.5



T: 1 mm
d: 0.9 – 1.1 – 1.3 – 1.5

T: 2 mm
d: 0.9 – 1.1 – 1.3 – 1.5

T: 3 mm
d: 0.9 – 1.1 – 1.3 – 1.5

- Faecal kinetics monitored during 4 periods of 106 hours
  (17 faeces samplings)

Faecal sampling → Wet sieving under high pressure water → Density separation (surfactant)

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↓

Ambient water

↙

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Ambient water

↙ Particles of densities 1.1 – 1.3 – 1.5 — *Photography*

↓

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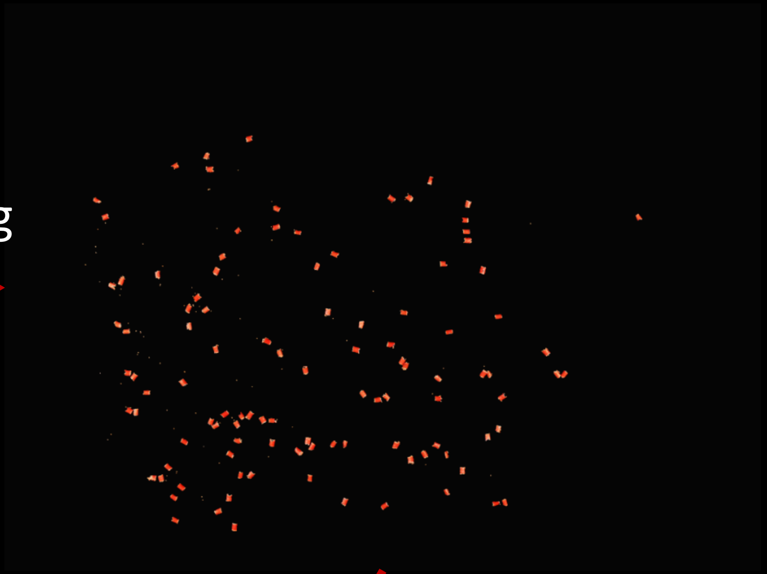
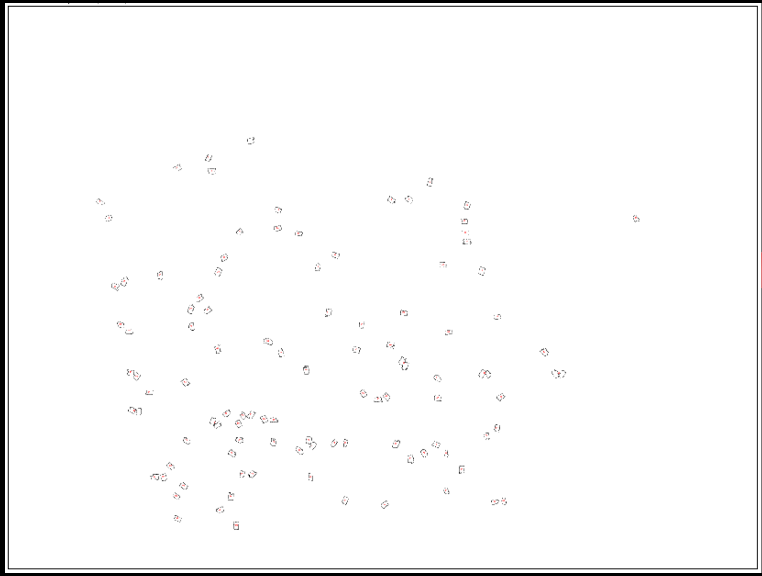
Photography

Image processing



Counting with ImageJ software



- Adjustment on a two exponential model *(Grovum and Williams, 1973)*

Rumen

- Total mean retention time = MRT1 + MRT2 + TT

Flow compartments

Mixing compartments

- No results for particles of 0.5mm size

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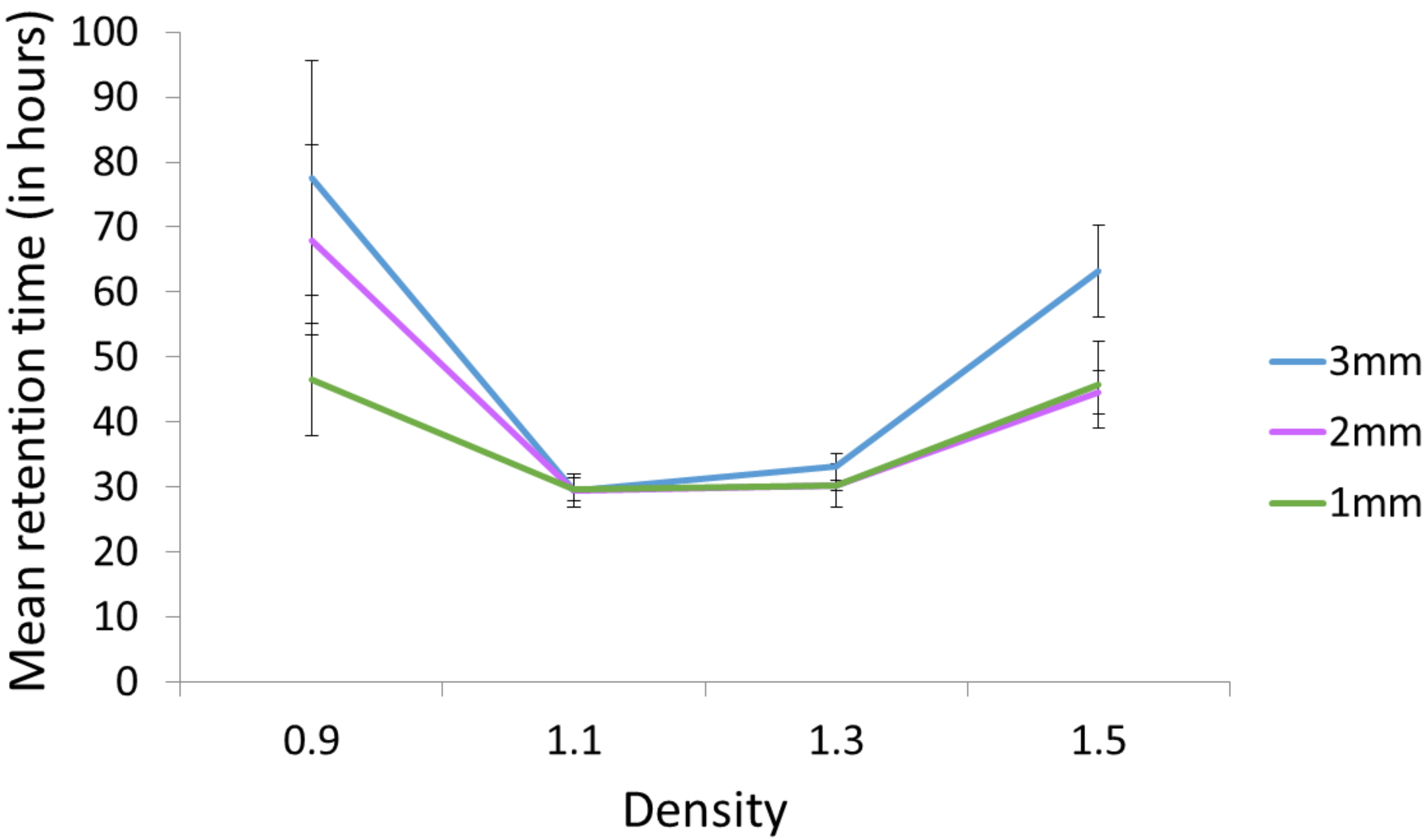
  - In the digestive tract



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- Quadratic response of density with an optimum between 1.1 and 1.3
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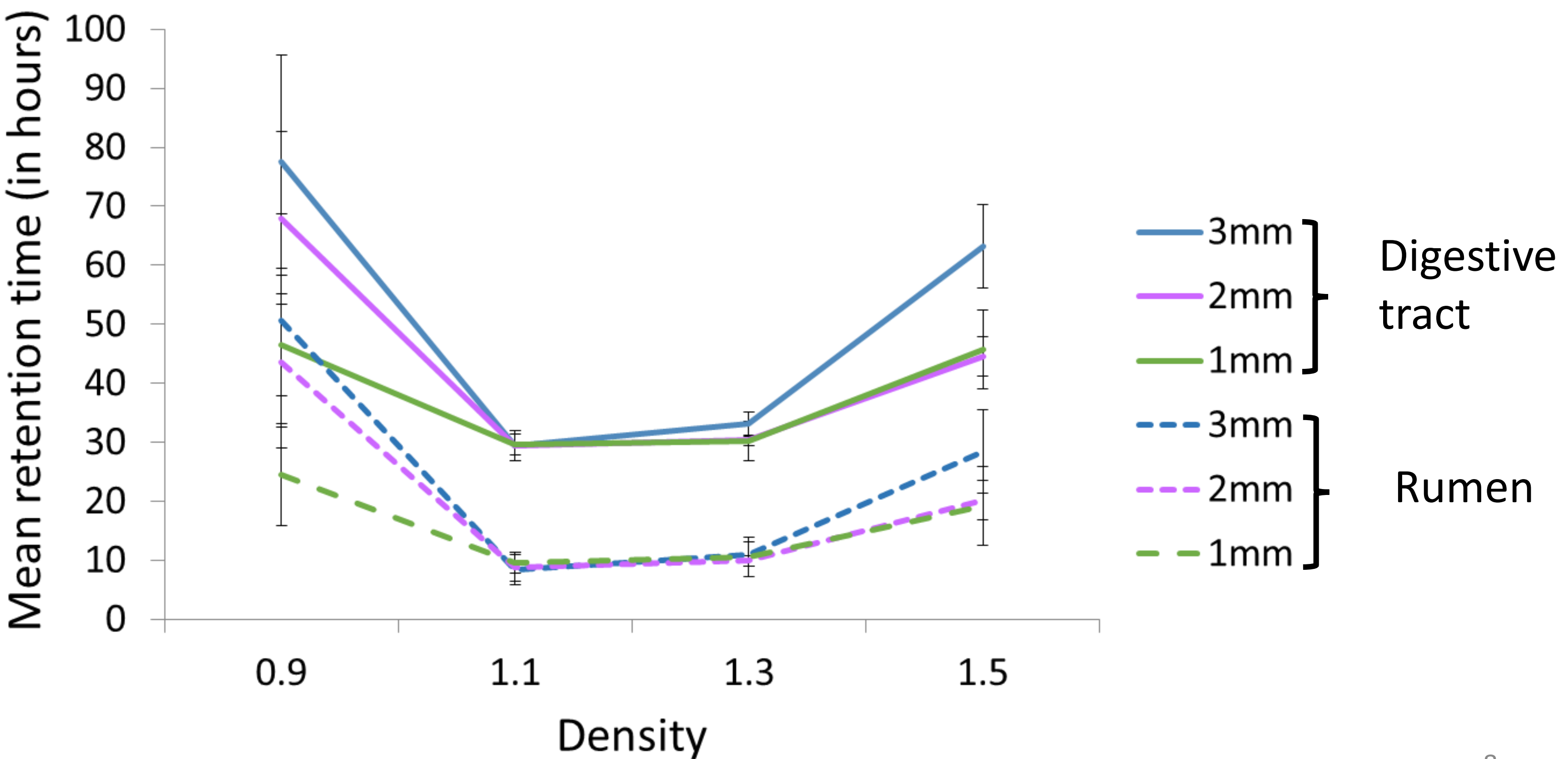

- Response of mean retention time to size
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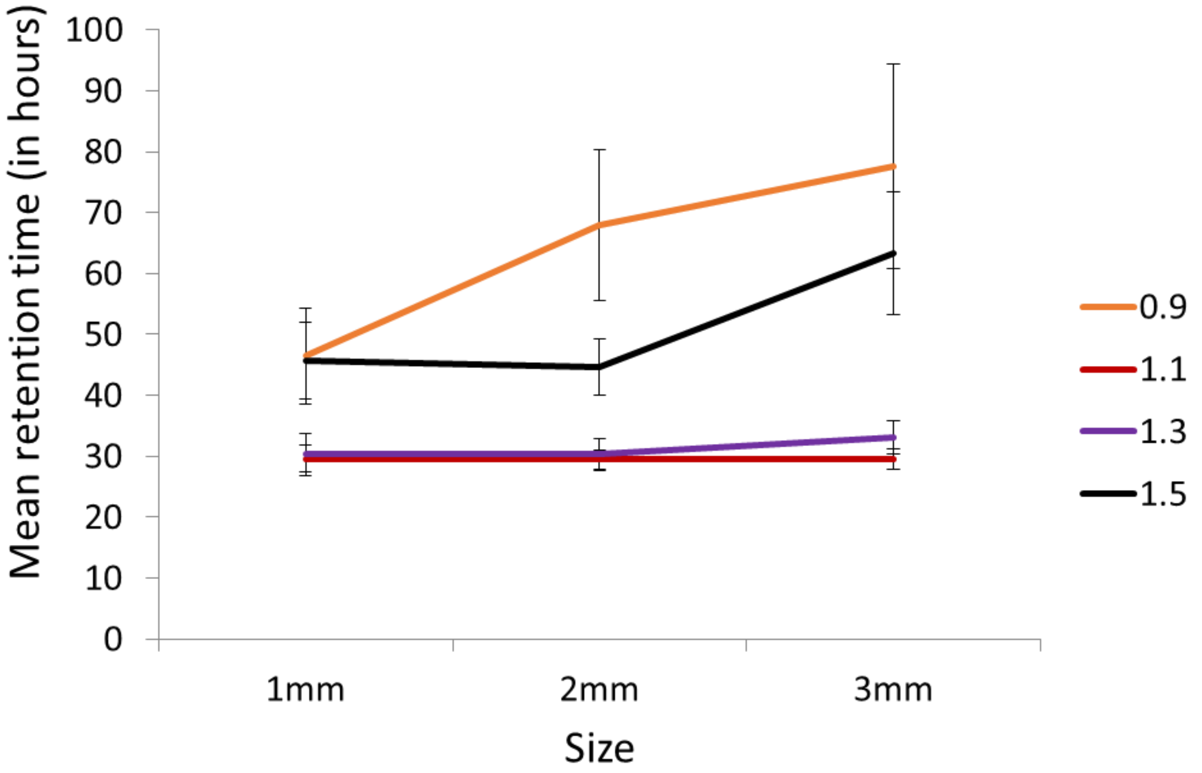
  - Increase with size for densities 0.9 and 1.5



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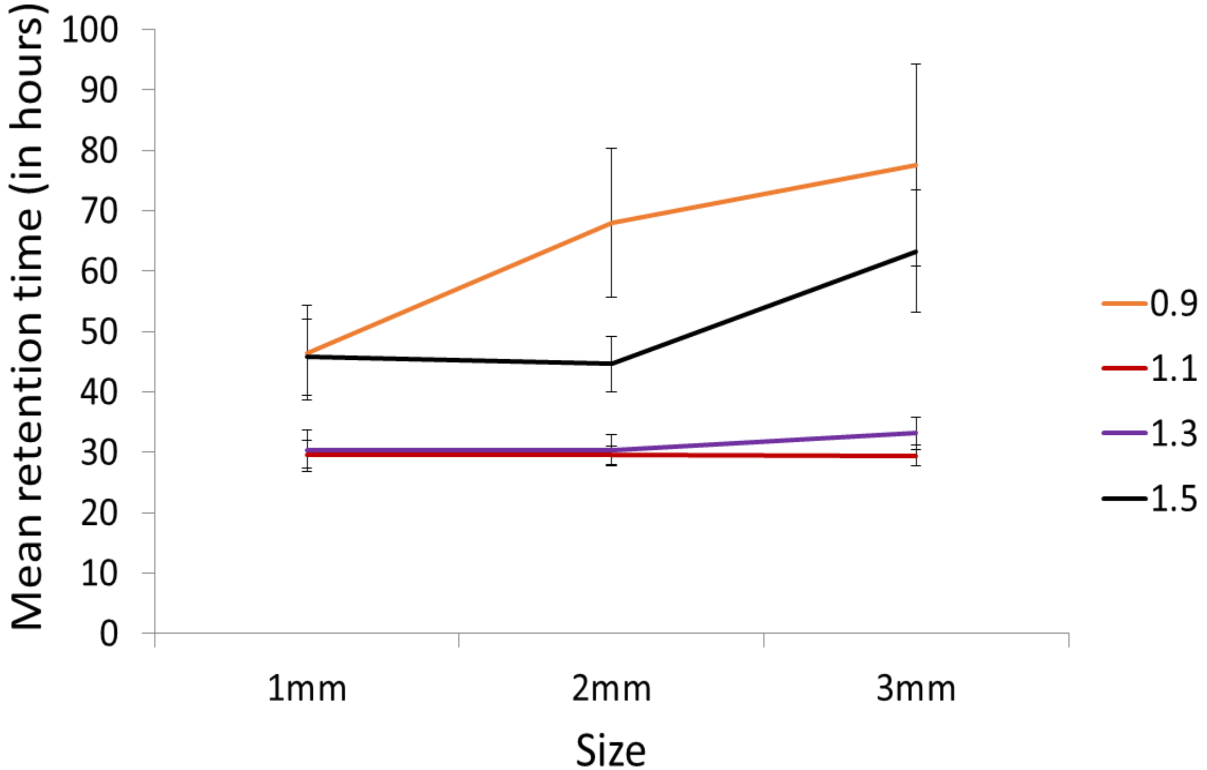

Particles with density comprised between 1.1 and 1.3 escape faster from the rumen whatever their size

- Plastic particles = no fermentation
- Applications to concentrates particles:
  - importance of the surface / mass ratio in the starts of microbial fermentations
    - Small particles loss their density more rapidly due to higher surface / mass ratio
  - Selection occurs at the reticulo-omasal orifice
    - Critical size theory (*Poppi et al. 1980*): 3-4mm

➢ Particle sizes around 3-4mm will delay the loss of density and allow the passage out of the rumen

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  - In the digestive tract
  - In the rumen
- Response of mean retention time to size
  - No effect for densities 1.1 and 1.3
  - Increase with size for densities 0.9 and 1.5
- Applications to concentrates
  - Feeds with a density between 1.1 and 1.3 and a size around 3-4mm may have the shortest time in the rumen
  - Changing the physical characteristics of concentrate particles could increase the efficiency of new protecting processes