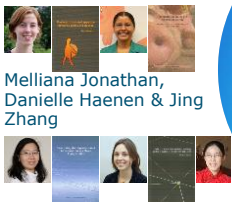



Novel insights from Wageningen UR PhD research

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SA satiety
satisfaction

Dietary fibre properties and satiety: in vivo studies

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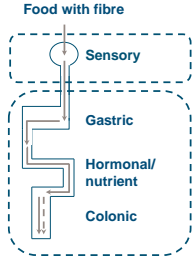
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Approach

Food with fibre

Fibre properties

Satiety



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Measuring satiety in humans

- Visual Analogue Scales (VAS)
 - Hunger
 - Fullness
 - Desire to eat
 - Prospective intake

The image shows a printed questionnaire with three horizontal scales. Each scale has '1' at the left end and '9' at the right end. The first scale is for 'Hoe veel honger heeft u op dit moment?' (How much hunger do you have at the moment?), with ' helemaal geen honger' (no hunger at all) on the left and ' heel erg honger' (very hungry) on the right. The second scale is for 'Hoe vol voelt u zich op dit moment?' (How full do you feel at the moment?), with ' helemaal niet vol' (not full at all) on the left and ' heel erg vol' (very full) on the right. The third scale is for 'Hoe graag zou u op dit moment iets willen eten?' (How much would you like to eat at the moment?), with ' helemaal niet graag' (not at all) on the left and ' heel erg graag' (very much) on the right. At the top, there are four rows of circles for marking answers: 'Productie' (Production), 'Dinamische' (Dynamic), 'Vragenlijst' (Questionnaire), and 'Onderzoek' (Research).



Studies in humans

- Systematic review
- 3 intervention studies



The pig as a model for humans

- Genome
- Digestive functions
- Body size
- Diet (omnivorous)
- Cognitive abilities
- Standardization
- Access to body tissues



Measuring satiety in pigs

- Operant test → "Paying for food"
 - More turns = Less satiated
- Runway test → "Running for food"
 - More speed = Less satiated



Studies in pigs

- 2 behavioural studies
- 1 invasive study



Overview fibre properties and satiety

Fibre property	Pig	Human
Bulky	↑	↔
Fermentable	↑	↔
Viscous	↓	↑

- Fibre type
- Fibre dosage
- Level of fermentation
- Level of hydration



Fibre type effects

Fibre property	Pig	Human
Bulky	↑ Lignocellulose	↔ Modified-Pectin
Fermentable	↑ Guar gum Inulin Resistant starch	↔ LM-Pectin
Viscous	↓ HM-Pectin	↑ HM-Pectin

Fibre dosage effects

Fermentable fibre	Dosage	Speed	Voluntary food intake
Guar gum	Low	↑	↔
	High	↓	↔
Inulin	Low	↑	↔
	High	↓	↔
Resistant starch	Low	↑	↑
	High	↓	↓

- High levels of guar gum, inulin and resistant starch (all fermentable) sustained satiety throughout the day
- Resistant starch (fermentable) most satiating

Overview fibre properties and satiety

Fibre property	Pig ≥5%	Human ≤3%
Bulky	↑ Lignocellulose	↔ Modified-Pectin
Fermentable	↑ Guar gum Inulin Resistant starch	↔ LM-Pectin
Viscous	↓ HM-Pectin	↑ HM-Pectin

Fermentation effects

Fermentable fibre	Rate of fermentation	SCFA profile
Guar gum	Moderate ($t_{max}=15.2$ h)	High in acetate
Inulin	Rapid ($t_{max}=8.4$ h)	High in propionate
Resistant starch	Slow ($t_{max}=35.3$ h)	High in butyrate

■ Slow rate of fermentation of resistant starch

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Souza da Silva et al, Physiology & Behavior, 2013
SA Satiety Deflection

Fermentation effects

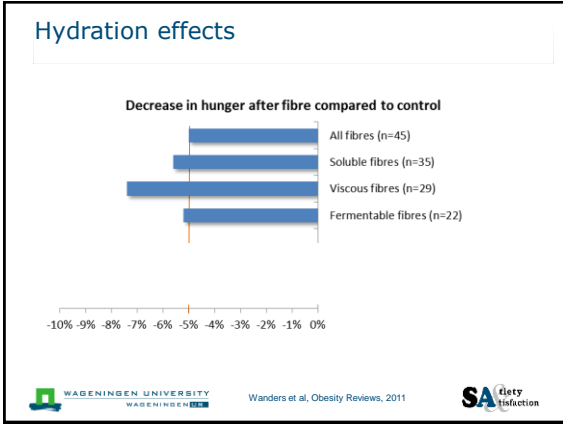
■ Increased plasma SCFA levels throughout the day after a resistant starch (RS)-meal

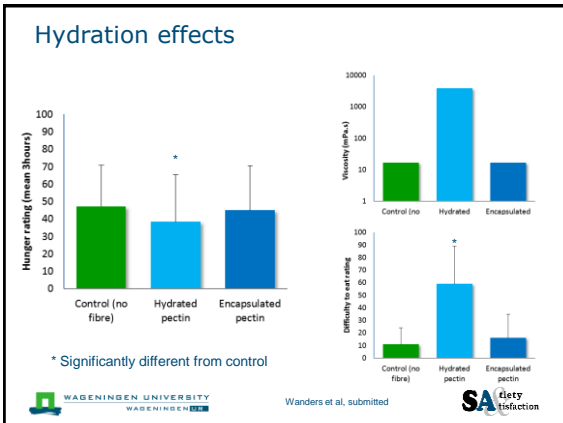
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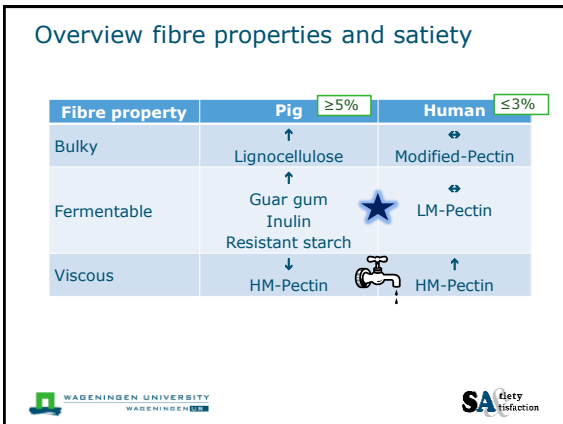
Overview fibre properties and satiety

Fibre property	Pig $\geq 5\%$	Human $\leq 3\%$
Bulky	Lignocellulose ↑	Modified-Pectin ↔
Fermentable	Guar gum Inulin Resistant starch ★	LM-Pectin ↔
Viscous	HM-Pectin ↓	HM-Pectin ↑

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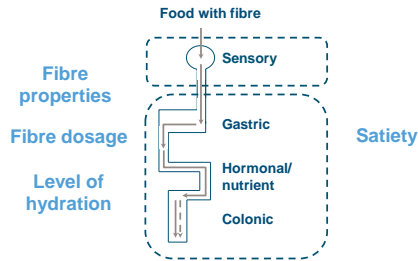


Key messages

- Different dietary fibres with different physicochemical properties have different effects on satiety
- In addition, level of hydration may interact with the effect on satiety
- Future studies need to provide information on:
 - Fibre type
 - Dose
 - Physicochemical properties
 - Food matrix
- It remains to be elucidated whether the findings in pigs and in humans are comparable



Approach



Thank you for your attention!

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Fibre properties

- Pectin (viscous) least satiating throughout the day
- Lignocellulose (bulking) most satiating for >3 h after the meal
- Resistant starch (fermentable) most satiating up to 7 h after the meal

Fibre (property)	Dosage (g/kg)	Operant responding	Speed
Lignocellulose (bulky)	50 and 100	↓	↔
Resistant starch (fermentable)	197 and 394	↔	↓
Pectin (viscous)	75 and 149	↑	↑


 Souza da Silva et al, Physiology & Behavior, 2012
 

Fibre dosage effects

- High levels of guar gum, inulin and resistant starch (all fermentable) sustained satiety throughout the day
- Resistant starch (fermentable) most satiating

Fermentable fibre	Dosage (g/kg)	Speed	Voluntary food intake
Guar gum	50	↑	↔
	100	↓	↔
Inulin	70	↑	↔
	140	↓	↔
Resistant starch	170	↑	↑
	340	↓	↓


 Souza da Silva et al, Physiology & Behavior, 2013
 

Gastric and hormonal effects

