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Combining fibres and proteins in a cereal product reduces appetite sensations with some effects on gastric emptying and gluco-insulinemic response

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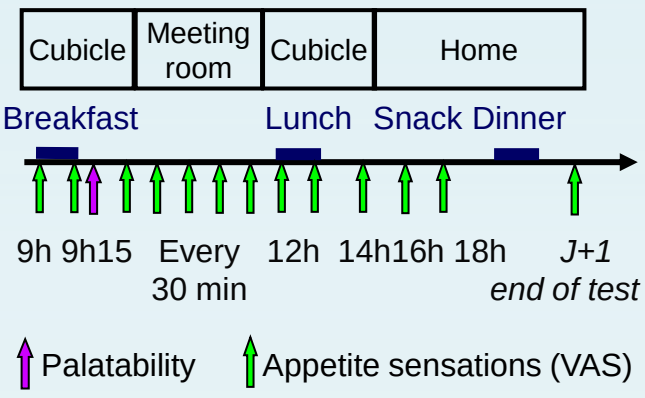
Background and Objectives:

The decreasing effects of proteins and fibres on appetite sensations have been largely assessed in the literature (Slavin, 2005; Westerterp-Plantenga *et al.*, 2009) but the association with decreased energy intake is not systematically found (Fischer *et al.*, 2004; Vitaglione *et al.*, 2010). In addition, few studies have focused on the effect of a combination of fibres and proteins on satiety in comparison to isocaloric control foods (Halford *et al.*, 2008; Lluch *et al.*, 2010; Keogh *et al.*, 2011) and the results do not allow drawing clear conclusion of their combined effect on satiety and energy intake (Karhunen *et al.*, 2010). **The objective of this study was to evaluate the single and potential combined effects of proteins and fibres in biscuits as well as the underlying peripheral mechanisms behind the expected satiety effects.**

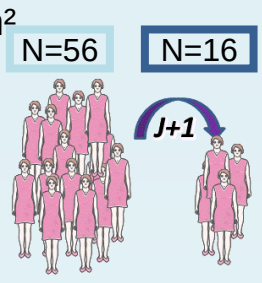
Methods:

Design PART A: 56 healthy women

Weight of food →**Energy intake (kJ)**
VAS →**Appetite sensations**
• 4 separate randomized sessions
• Each session= one type of biscuit



Mean BMI= 21.8 ± 0.2 kg/m²
Mean age= 24.5 ± 0.6 yrs
TFEQ scores:
Cognitive restraint= 4 ± 0.3
Disinhibition= 5 ± 0.3
Hunger= 4 ± 0.3



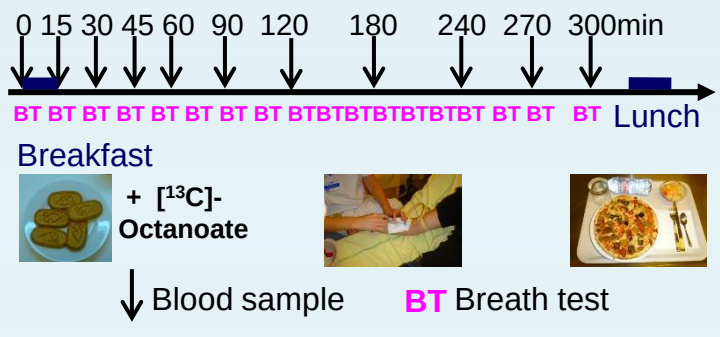
Quantity (g) per portion of 250 kcal	P*	CHO	F*	Fat
Control (C)	5	38	3	8
12% Fibres (HF)	7	33	6	9
23% Proteins (HP)	12	29	2	9
12 % Fibres + 23% Proteins (HPHF)	14	25	6	9

* P=proteins F=fibres

Design PART B: 16 healthy women

Same criteria of age, BMI and TFEQ

• **Gastric emptying:** ^{13}C enrichment breath test
• **Physiological markers:** insulin, GLP-1, glucagon, ghrelin, PYY, CCK
• **Metabolite:** glucose



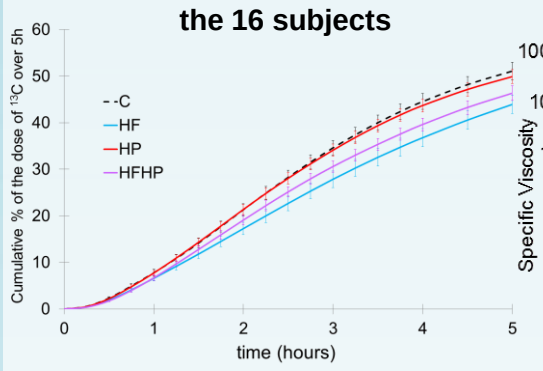
Results:

Appetite and food intake

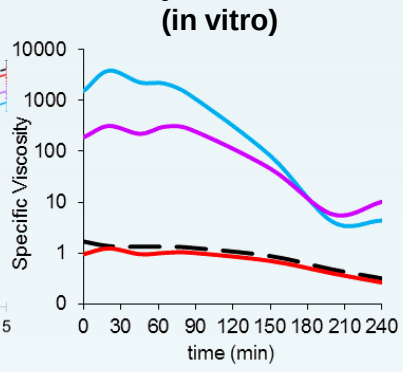
Appetite sensations:
• **HPHF** reduced hunger, prospective consumption and desire to eat compared to **C**, **HF** and/or **HP**. Therefore **HPHF** reduced the average appetite score compared to **HP** with a tendency compared to C and **HF**.
• **Food intake:** No effect is observed

Gastric emptying and viscosity

Excreted cumulated ^{13}C for the 16 subjects



Viscosity in the stomach (in vitro)

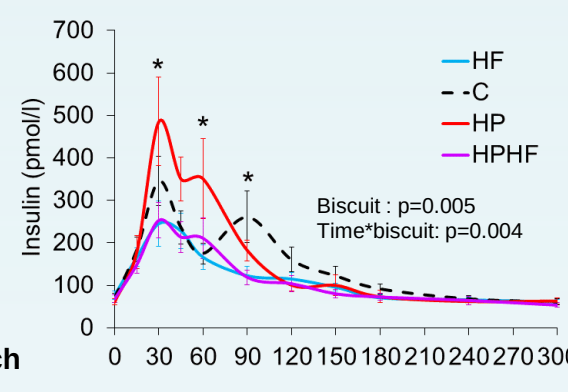


➢ Slower gastric emptying after:
• Both **HPHF** and **HF** than the control
• **HF** than **HP**

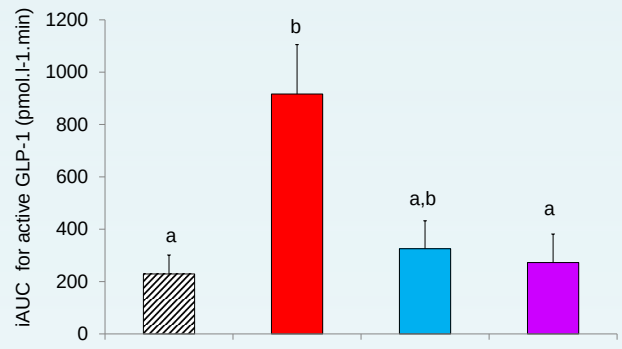
Consistent with in vitro data on viscosity

Effects of biscuits on gluco-insulinemic responses

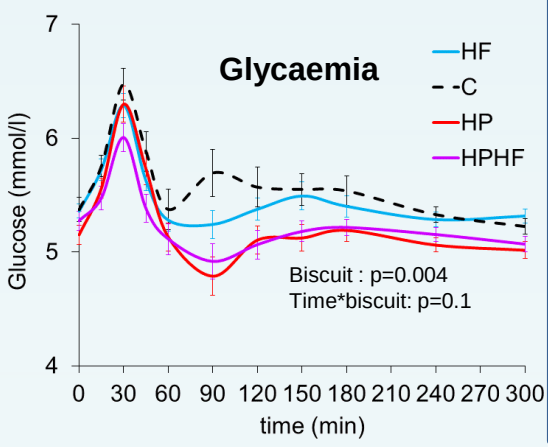
Insulinemia



Active GLP-1



Glycaemia



• Insulinemia was higher after **HP** (T60) and lower after **HPHF** and **HF** (T90) vs. C
• Peak insulinemia 30 min after breakfast was lower after **HPHF** and **HF** vs. **HP**
• **HP** biscuit increases active GLP-1
• The glycaemia level was lower after **HPHF** and **HP** vs. C

Conclusions:

A combination of fibres and proteins transiently reduces appetite sensations but the effect might be too small to induce lower food intake. **HPHF** induces a slow down of gastric emptying and then a slowed gluco-insulinemic response. Similar physiological effects are observed after the **fibre-enriched** biscuit although no effect on appetite sensations. The **protein-enriched** biscuit shows no effect on appetite, a decreased glycaemia, an increased insulin secretion and increased active GLP-1.
Our results are consistent with some in vitro mechanisms such as induced viscosity but **no possible clear link between physiological markers and satiety can be made. The difference in palatability, both the nature and the energy level of the food carriers could have influenced the results.**

Keywords: combination of fibres and proteins, satiety, physiological markers