Foods 2022
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BioNutesT

Adaptation of the INFOGEST digestion for the elderly population to assess sterol bioaccessibility in a plant sterol-enriched wholemeal rye bread

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INDEX

Elderly population

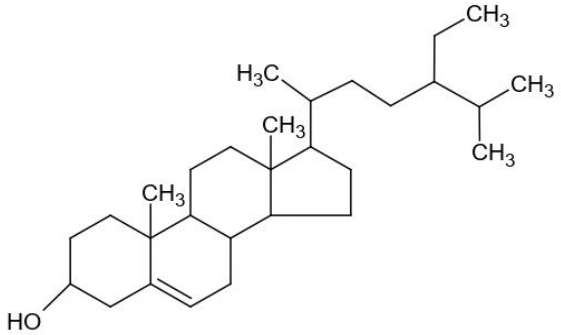
≥ 65 years old

Physiological decline[2]

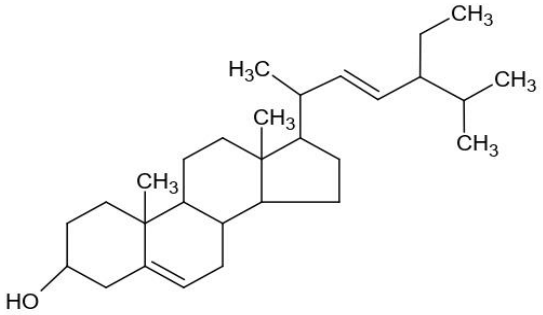
Increase in chronic disease risk factors: hypercholestolemia[1]

[1]Boss, G.R. West J Med, 1981, 135:434-440, [2]Amarya. In: Gerontology, IntechOpne, chapter 1

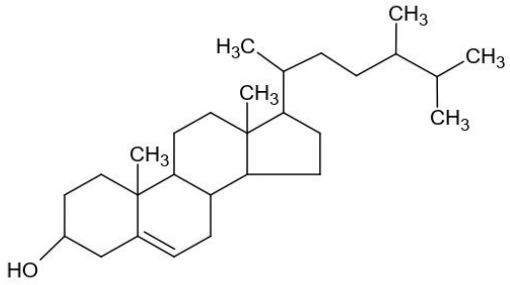
PLANT STEROL (PS)–ENRICHED FOODS



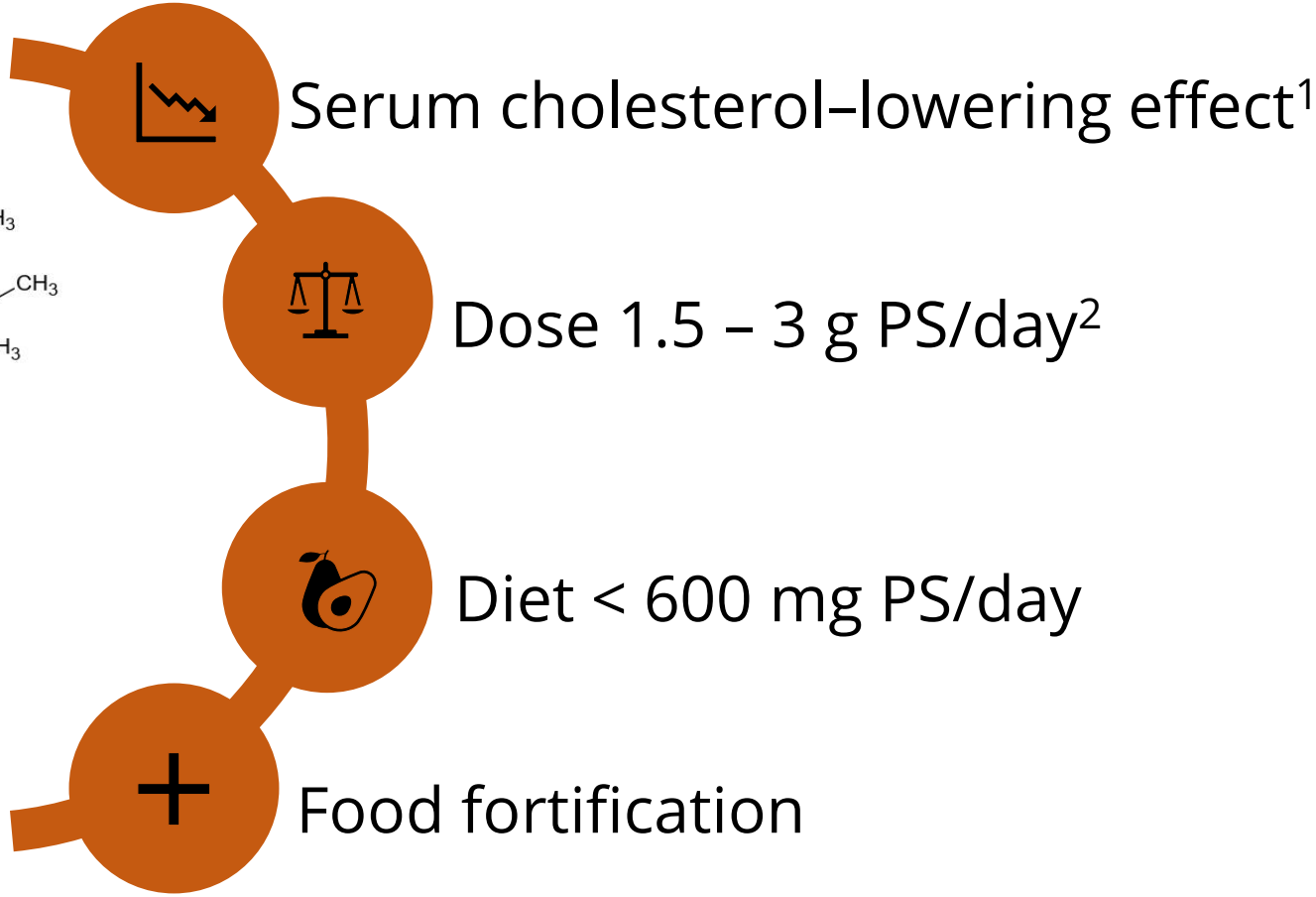
β-Sitosterol



Stigmasterol

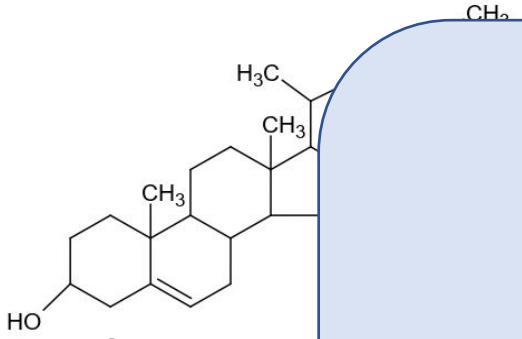


Campesterol



[1]Poli et al. Nutrients, 2021, 13, 2810. [2]Regulation (EU) No 983/2009; Regulation (EU) No 432/2012; Regulation (EU) No 686/2014; PS: plant sterols

PLANT STEROL–ENRICHED FOODS



β-Sitostero

owering effect

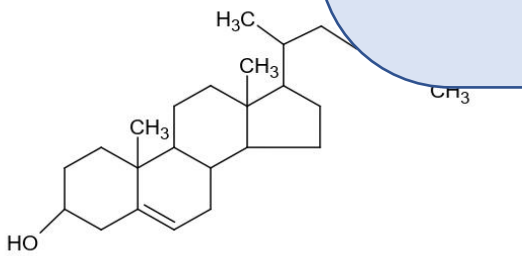
S/day

/day

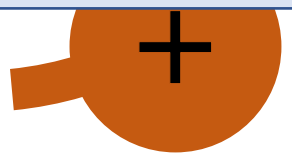
Wholemeal rye bread

Bioaccessibility

Decision 2006/58/CE. OJ 03/02/2006. L31/18 Decision 2006/59/CE. OJ 03/02/2006. L31/21



Campesterol



Food fortification

Poli et al. Nutrients, 2021, 13, 2810. Regulation (EU) No 983/2009; Regulation (EU) No 432/2012; Regulation (EU) No 686/2014; PS: plant sterols

OBJECTIVES

To adapt the standardized INFOGEST 2.0 method for the adult to the elderly physiological conditions.

To assess the plant sterol bioaccessibility of an enriched wholemeal rye bread under elderly conditions

Sample

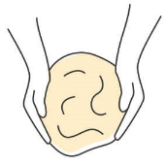
PS–enriched wholemeal rye bred (2.3%, w/w)

- Wholemeal rye flour
- PS-ingredient
- Salt
- Water
- Ascorbic acid
- Yeast

Manufacturing

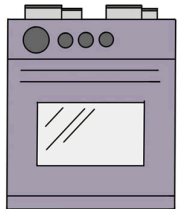
Kneased (11 min)

10 min →



Divided and rolled

15 min → Fermentation →



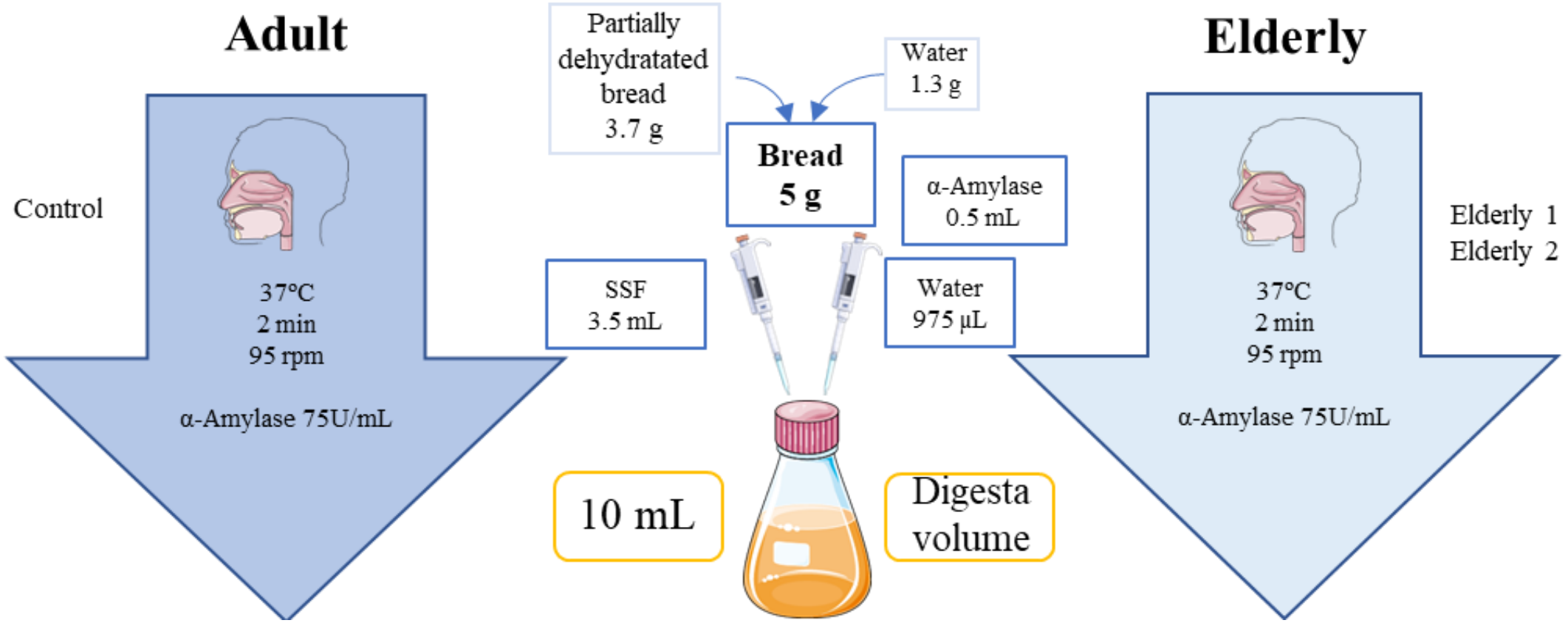
28ºC/45 min/85% RH

180ºC/25 min

After baking → Partial dehydration (until humidity < 14%, w/w)

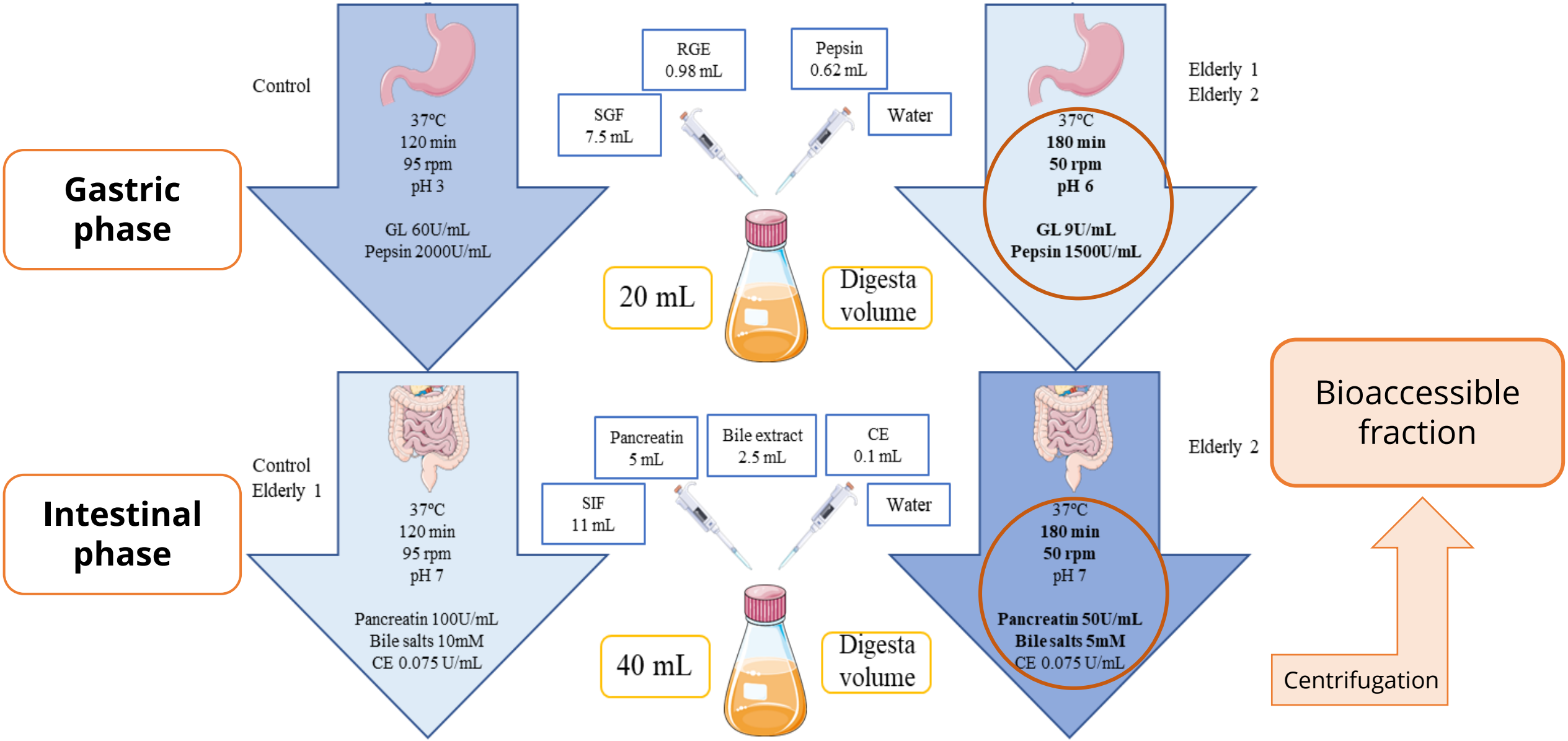
PS: Plant sterols; RH: relative humidity

Simulated gastrointestinal digestion: oral phase



Shani-Levi et al. Trends Food Sci Technol, 2017, 60, 52-63; Makran et al. Food Chem, 2022, 382, 132305; SSF: Simulated salivary fluid

Simulated gastrointestinal digestion



Shani-Levi et al. Trends Food Sci Technol, 2017, 60, 52-63; Makran et al. Food Chem, 2022, 382, 132305; SGF: Simulated gastric fluid; SIF: Simulated intestinal fluid; RGE: Rabbit gastric extract; CE: Cholesterol esterase

Sterol content determination

PARTIALLY DRIED RYE BREAD (0.35 g)
Internal standard (IS): Epicoprostanol, 1 mg

↓

Acid hydrolysis
HCl 6M/5mL, 60 min

↓

Lipid extraction
Hexane:diethyl ether (1:1, v/v) 20 mL

→

BIOACCESSIBLE FRACTION (2 g)
IS 0.2 mg

↓

Saponification
Saturated KOH 80ºC, 30 min

↓

Extraction of unsaponifiable fraction
Cyclohexane 20 mL, 400 rpm, 10 min

↓

Purification with solid phase extraction

→

Derivatization
Pyr:HDMS:TMCS (5:2:1, v/v/v)
0.6 mL, 25 min, 40ºC

Chromatographic conditions

GC-FID YL Instrument 6500 System

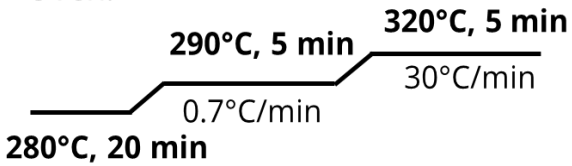
CP-sil 8 low bleed/MS, 50 m x 0,25 mm x 0,25 µm

Carrier gas: H_2 (2 mL/min)

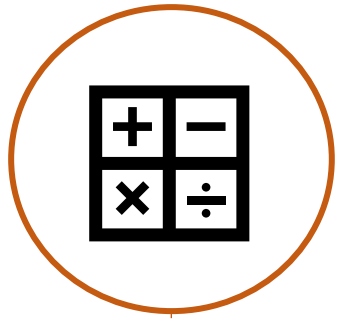
Inyector: 325°C (split 1:20)

Detector: 325°C

Oven:



Piironen et al. Cereal Chem, 2002, 79, 148-154. Makran et al. Food Chem, 2022, 382, 132305; GC–FID: gas chromatography-flame ionization detection; HDMS: hexamethyldisilazane; Pyr: pyridine; TMCS: trimethylchlorosilane

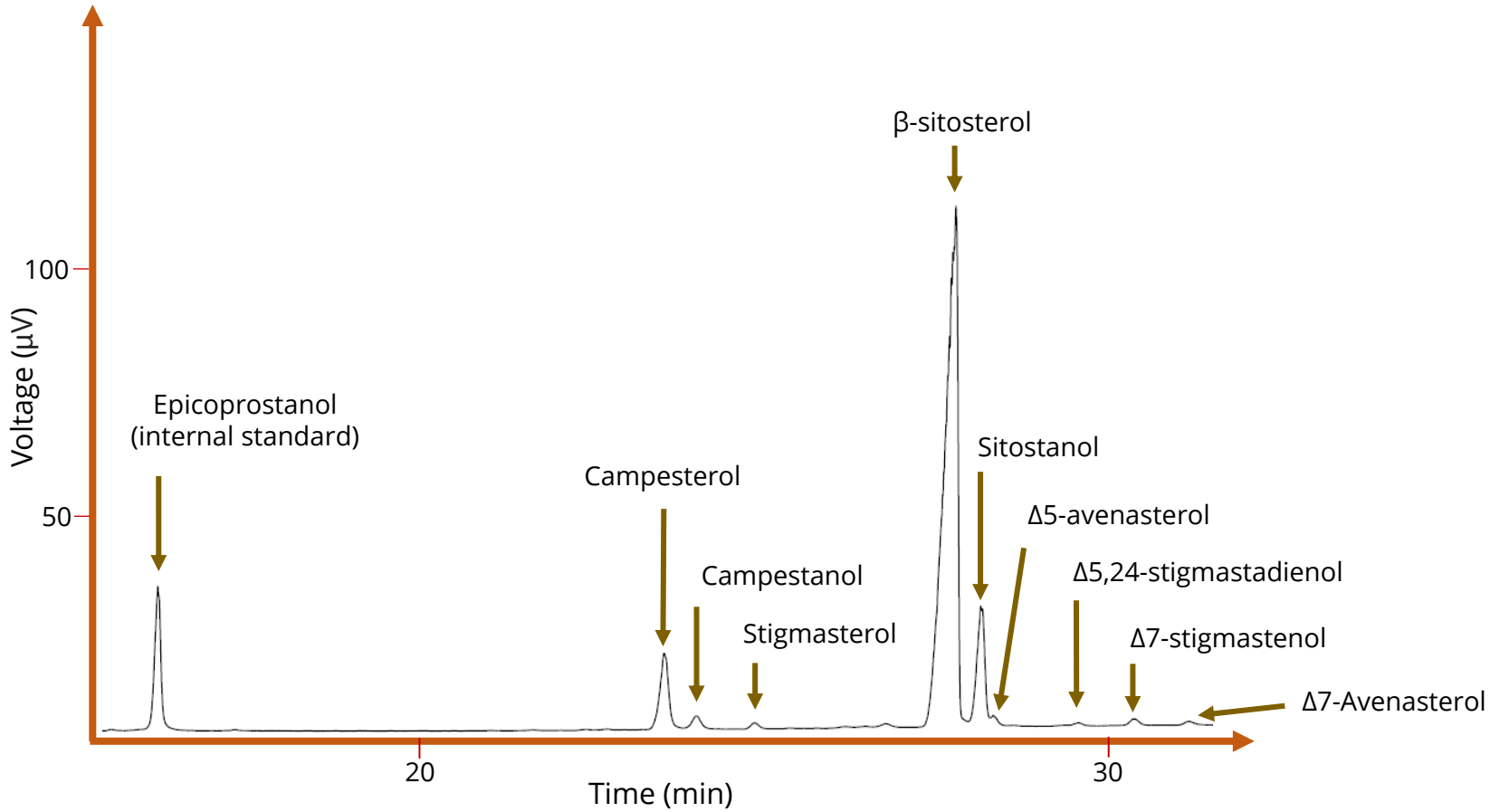


Plant sterol bioaccessibility in wholemeal rye bread

$$\text{Bioaccessibility (\%)} = \frac{\text{Sterol content in bioaccesible fraction}}{\text{Sterol content in rye bread}} \text{ X } 100$$

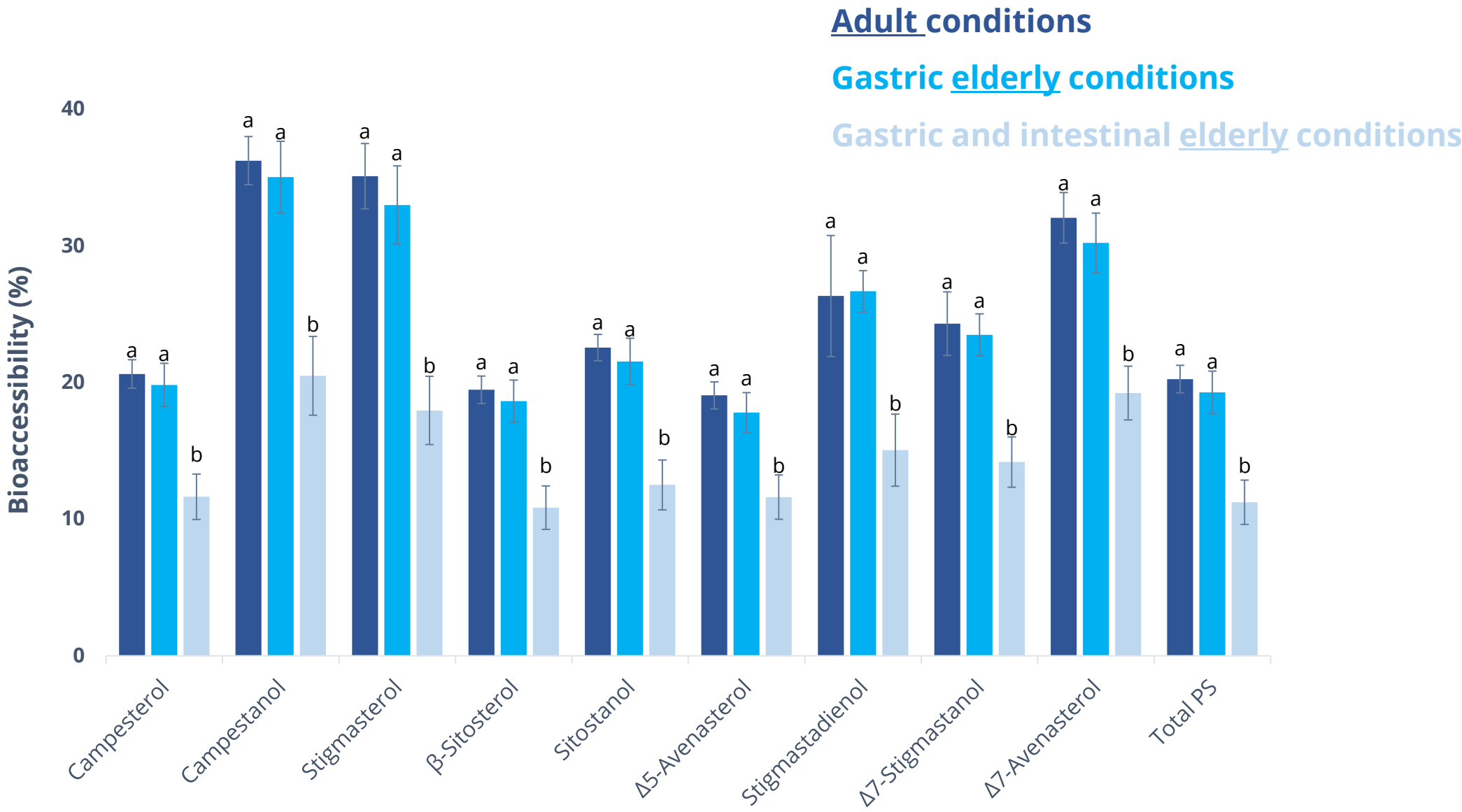
Makran et al. Food Chem, 2022, 382, 132305

Wholemeal rye bread

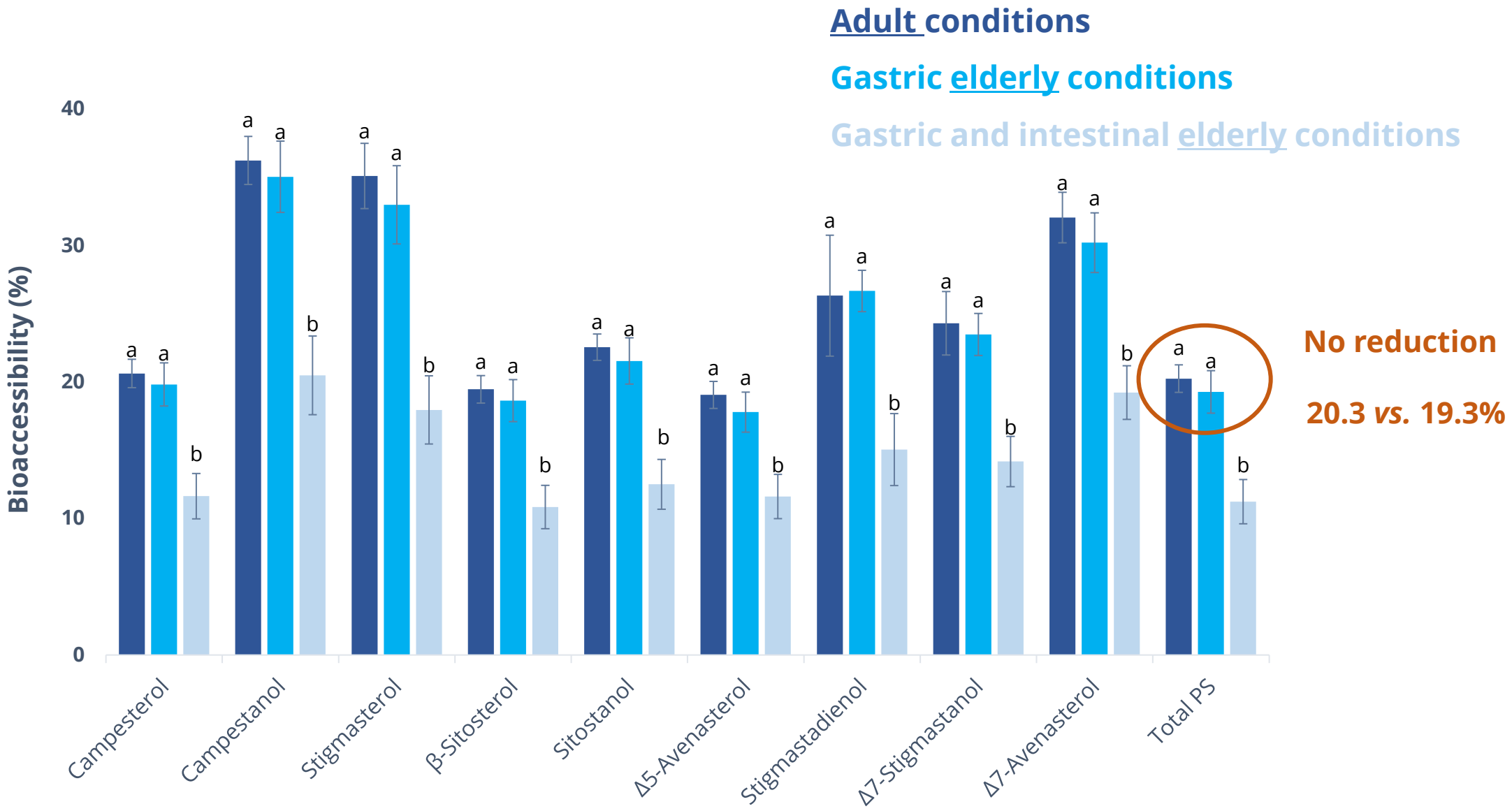


PS profile according to European regulations

Decision 2006/58/CE. OJ 03/02/2006. L31/18 Decision 2006/59/CE. OJ 03/02/2006. L31/21



Different lowercase letters (a-b) indicate statistically significant differences ($p < 0.05$) in the bioaccessibility of each sterol between digestion conditions



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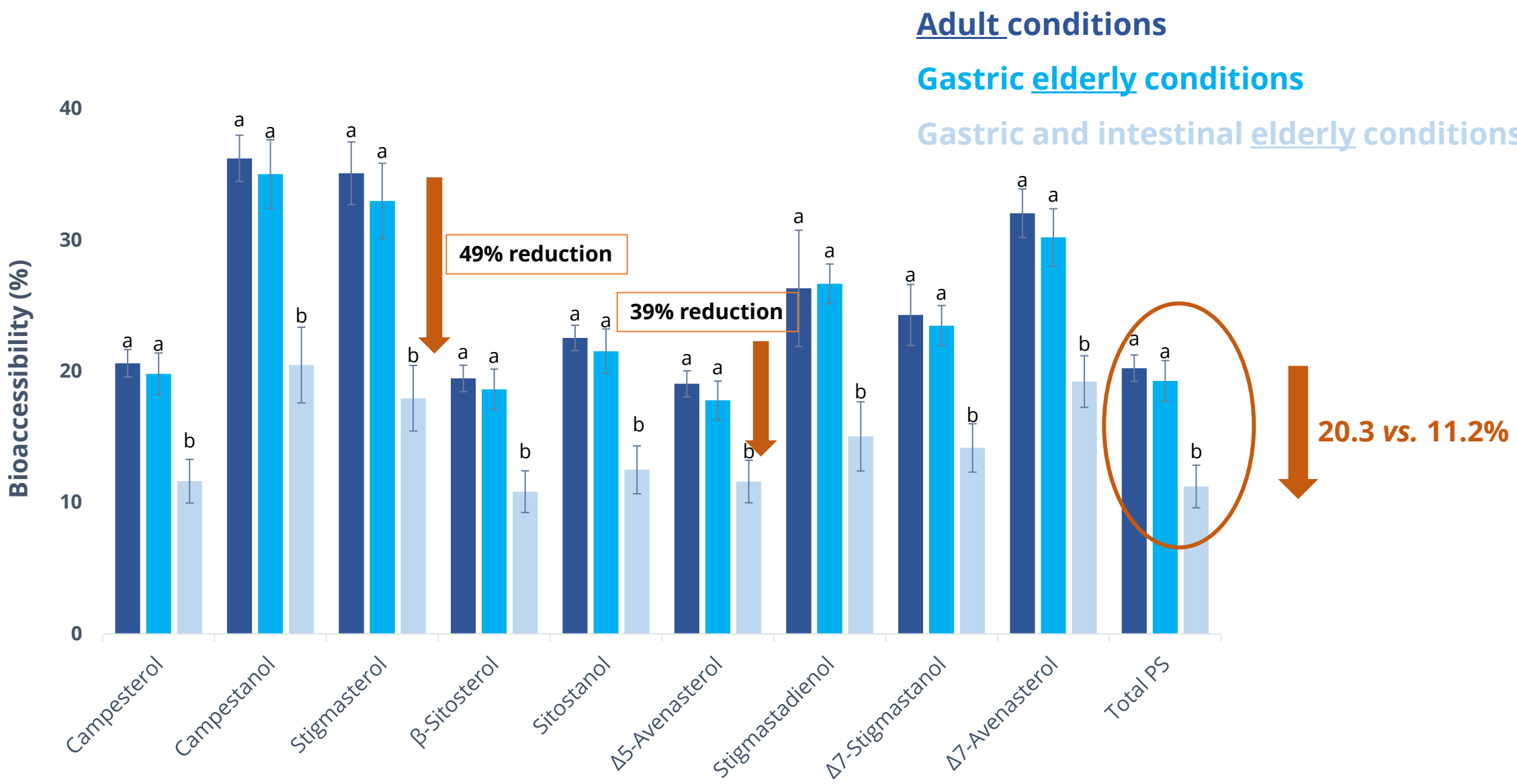

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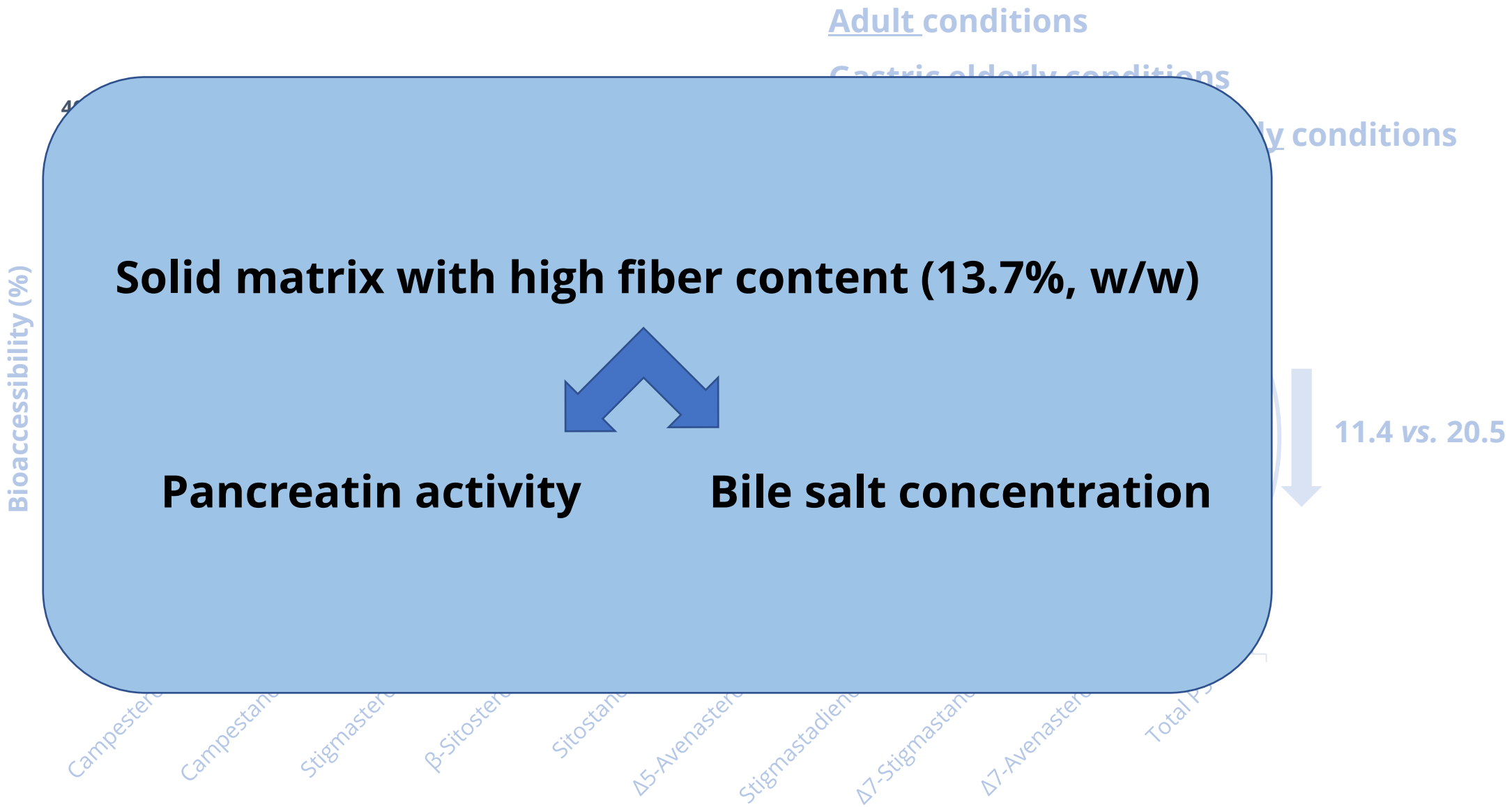

Different lowercase letters (a-b) indicate statistically significant differences ($p < 0.05$) in the bioaccessibility of each sterol between digestion conditions

- The elderly gastrointestinal adapted conditions decrease (*vs.* adult) the bioaccessibility of plant sterols in an enriched wholemeal rye bread, probably due to the solid nature of the matrix and its fiber content

- Nevertheless, the enriched wholemeal rye bread can be an adequate food for the elderly population. Its good nutritional profile is the main factor for this recommendation.

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Thanks for your attention

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