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SP3 subproject

Assessing metabolic health effects of carbohydrates in vivo

CarboHealth Symposium 2017

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Food for the microbiome

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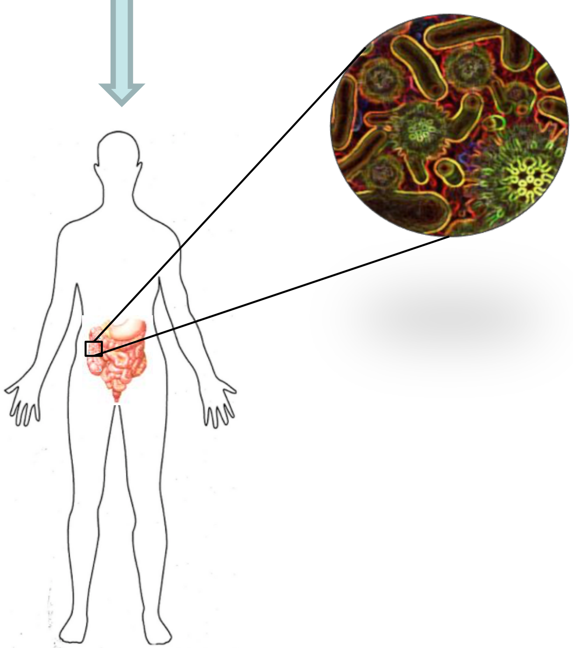
- Carbohydrate polymers that are not hydrolysed by digestive enzymes are fermented by gut microbes

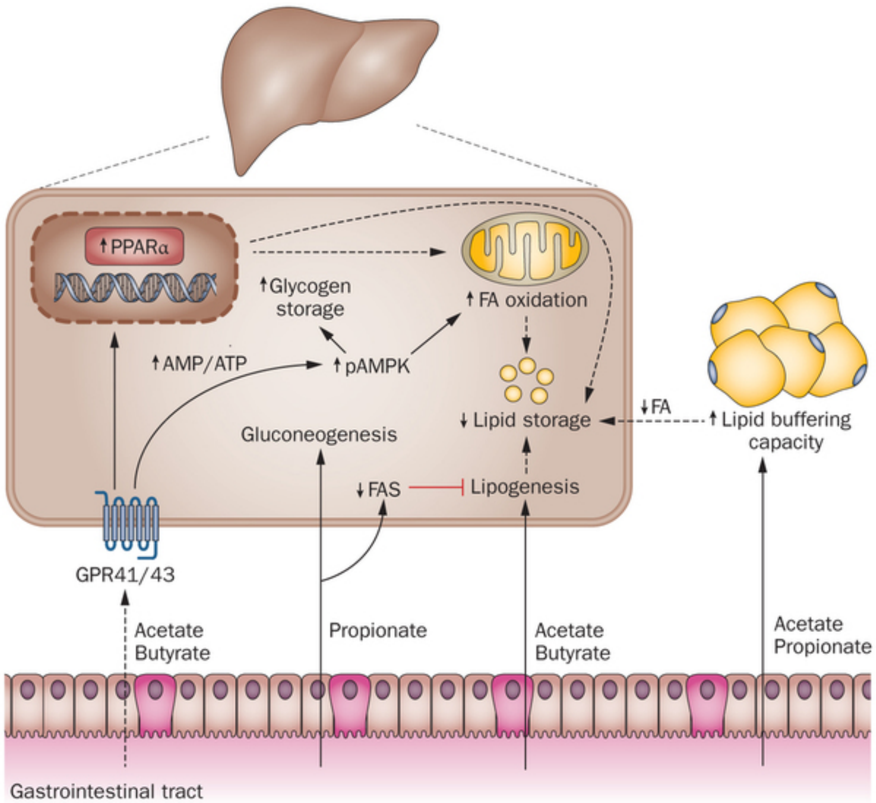


Bioactive metabolites

(eg. SCFA, BA modification enzymes, vitamins, lipid metabolites)

Beneficial physiological and immunological effects

SCFA and hepatic metabolism



- Dietary carbohydrate derived SCFA might act as a substrate for gluconeogenesis and de novo lipogenesis

Canfora E et al., Nat. Rev. Endocrinology, (2015)

Key questions

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- How does dietary carbohydrate modulate the composition and the metabolic properties of gut microbiota and subsequently metabolic health of the host?

- What is the role of dietary carbohydrate in reducing the risk of developing metabolic syndrome (type II diabetes, insulin resistance, atherosclerosis, NAFLD/NASH etc)?

A toolbox for carbohydrate selection

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In vitro screening: Structural, functional and bioconversion of carbohydrates

Effects on immune system and on the microbiota

Metabolic health effects of carbohydrates *in vivo*

Cholesterol metabolism

- Lipid profiling
- Continuous bile cannulation
- Lipid/cholesterol synthesis rate
- Intestinal chol. absorption

Insulin resistance

Impact of carbohydrates on development of Insulin resistance/T2DM

Human study

EFSA

A toolbox for carbohydrate selection

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Fructooligosaccharides (FOS)

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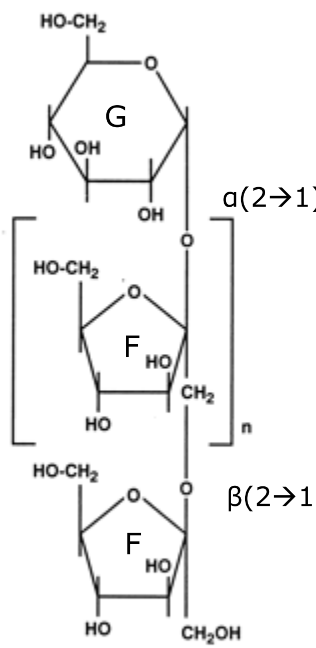
- β(2→1) linkages prevent FOS from digestion by human intestinal enzymes.
- Undergo fermentation by colonic microflora and are known to promote growth of beneficial bacteria.
- D-fructose with β(2→1) linkage and varied degree of polymerization (DP)
  - Long-chain inulin DP n=8-58
  - Short-chain inulin DP n=0-38
  - Oligofructose DP n=1-9
- Dietary lc- and sc- inulin efficiently generates SCFA *in vivo.*



Isomalto/malto-polysaccharides (IMMP)

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- A new class of soluble dietary fiber derived using 4,6 α – glucanotransferase GTFB enzyme and potato starch
- GTFB enzyme converts α 1→4 into α 1→6 linkage
- 91% has (α 1→6) linkages; 9%(α 1→4) linkages
- In vitro fermentation with human fecal microbiota showed increased total SCFA (Fangjie, Henk, WUR).

Galactooligosaccharides (GOS)

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- Growing evidence suggests that increasing consumption of dietary fibers could delay onset of T2DM.

- GOS are prebiotics recognized for their various health benefits such as: intestinal microbiota modulation, alleviation of constipation, reducing adherence of pathogenes to the epithelial intestinal cells.

- Used in infant formula to stimulate growth of intestinal bifidobacteria and lactobacilli.

Effects of non-digestible oligosaccharides (OS) on (chole-)sterol homeostasis in mice.

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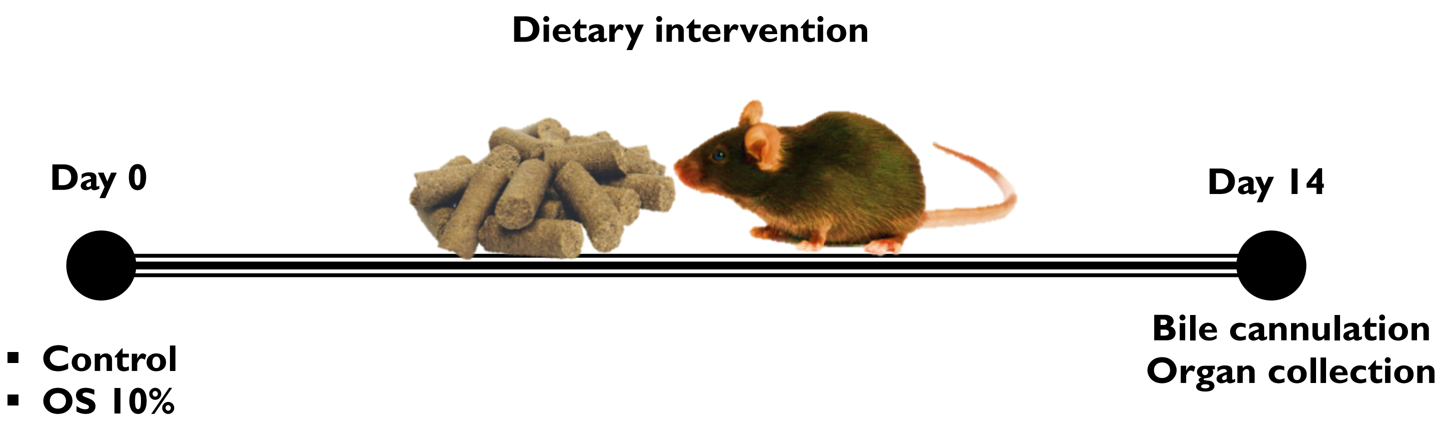

(Chole-)sterol metabolism

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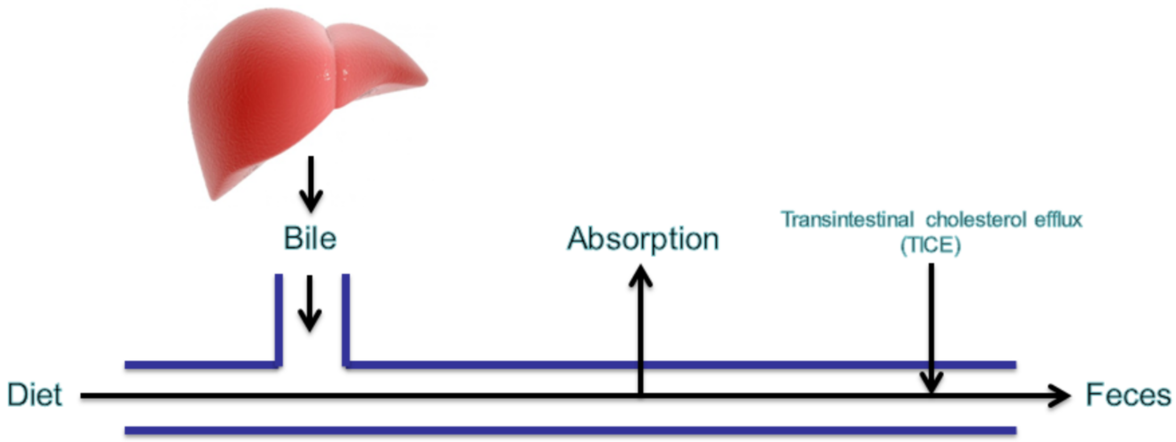
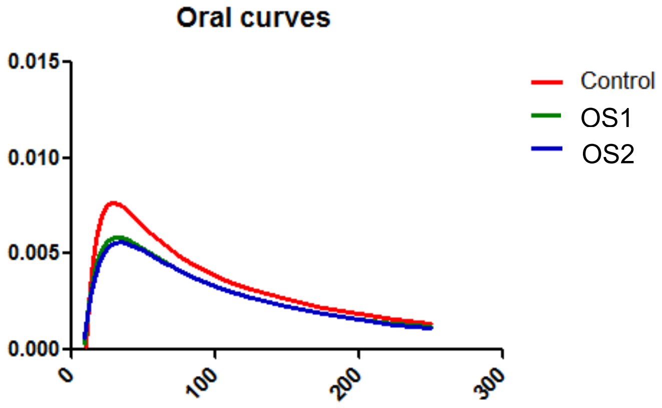
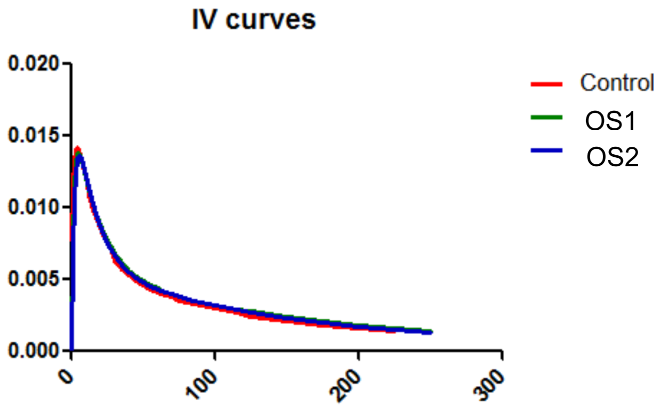


Cholesterol-D5 and -D7 fecal dual isotope cholesterol absorption studies





The given oligosaccharides have no adverse effects on cholesterol metabolism in wildtype mice

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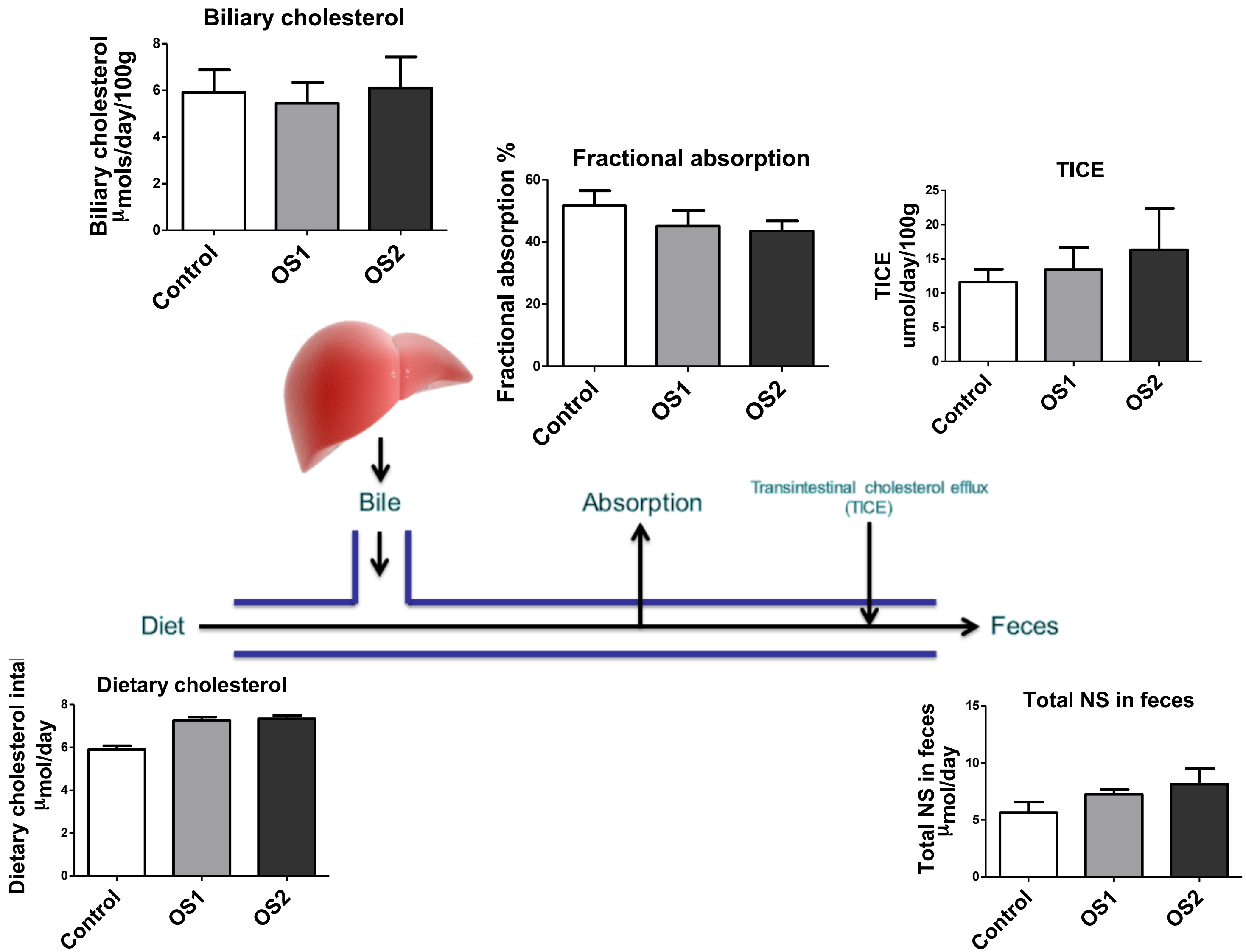

Conclusion

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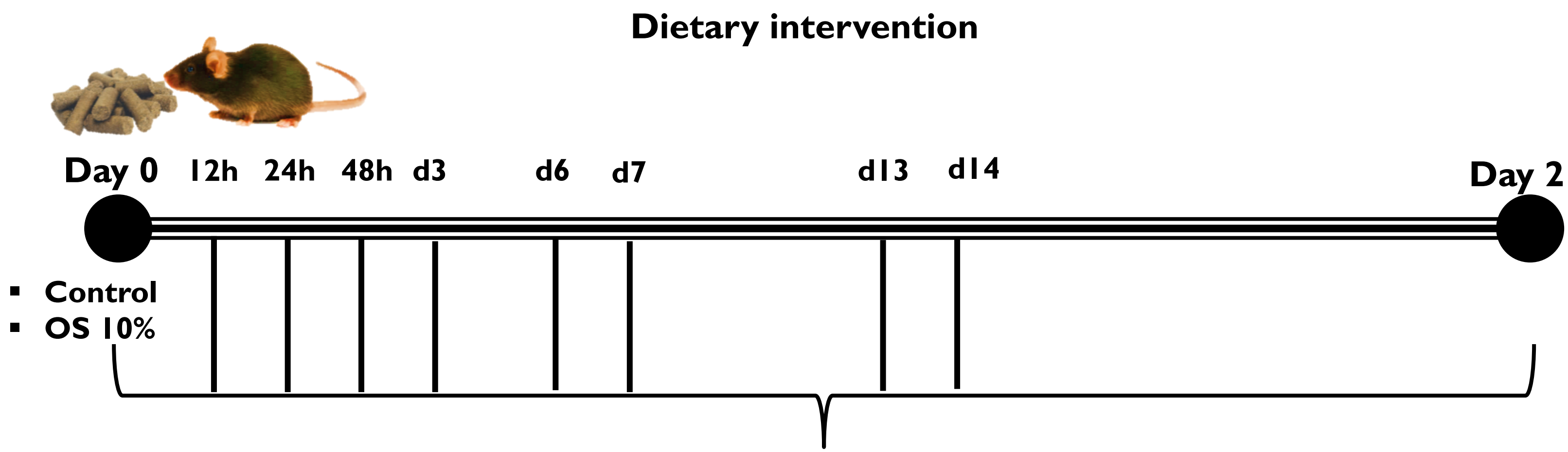
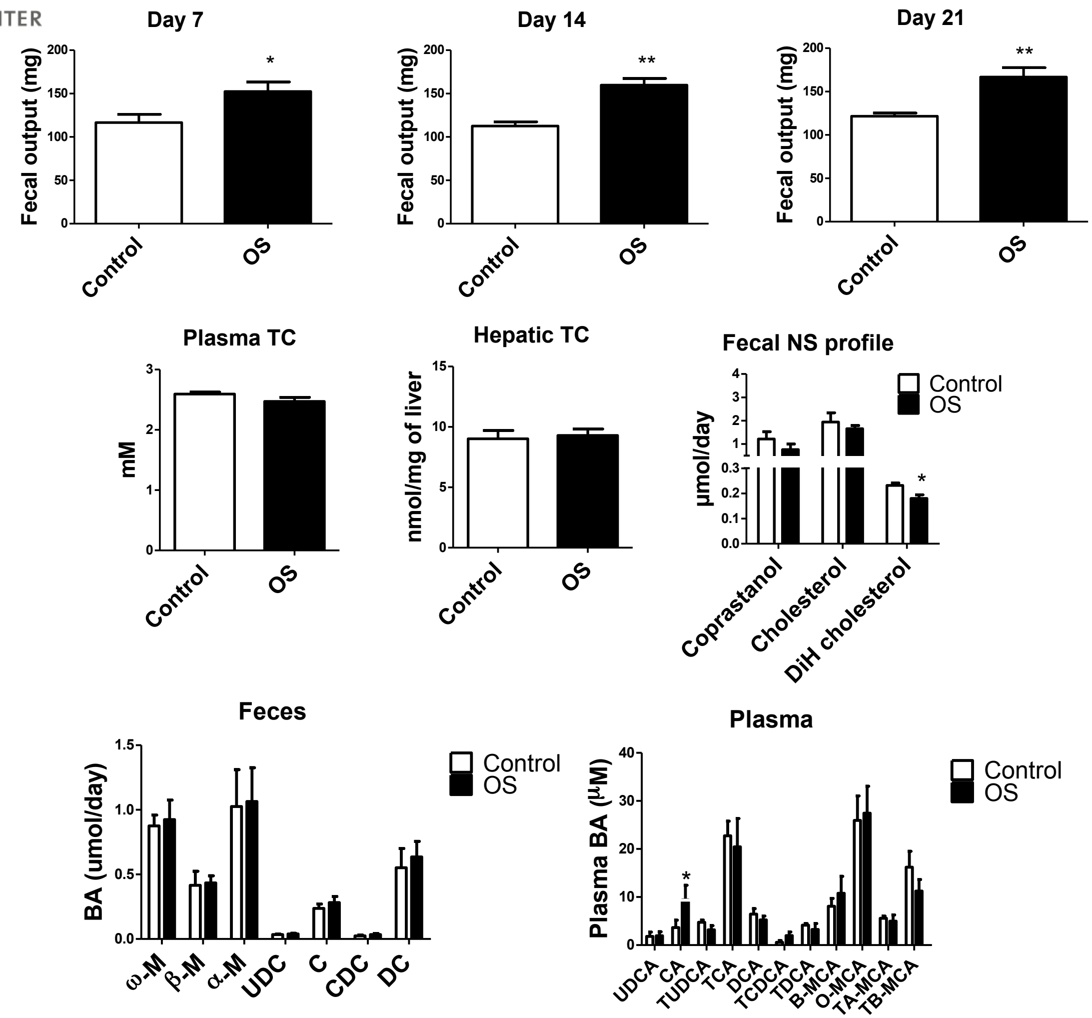
Dietary oligosaccharides efficiently generates SCFA and has no adverse effects on cholesterol metabolism in wt mice

Investigating effects of oligosaccharides on bile acid metabolism



- Structural analysis (SP1)
  Atomic absorption spectrometry (AAS),
  HPLC (scfa), HPAEC (os)
- Microbial composition (SP4)
  illumina miseq

Dietary oligosaccharides increases fecal bulk but does not impact cholesterol and BA metabolism in healthy wt. mice



Fecal bulk

Cholesterol

Bile acids

- Plasma, hepatic and fecal cholesterol content remained unchanged.
- Structural (SP1) and microbial assessment (SP4).

What is the role of oligosaccharides in development of insulin resistance and T2DM?

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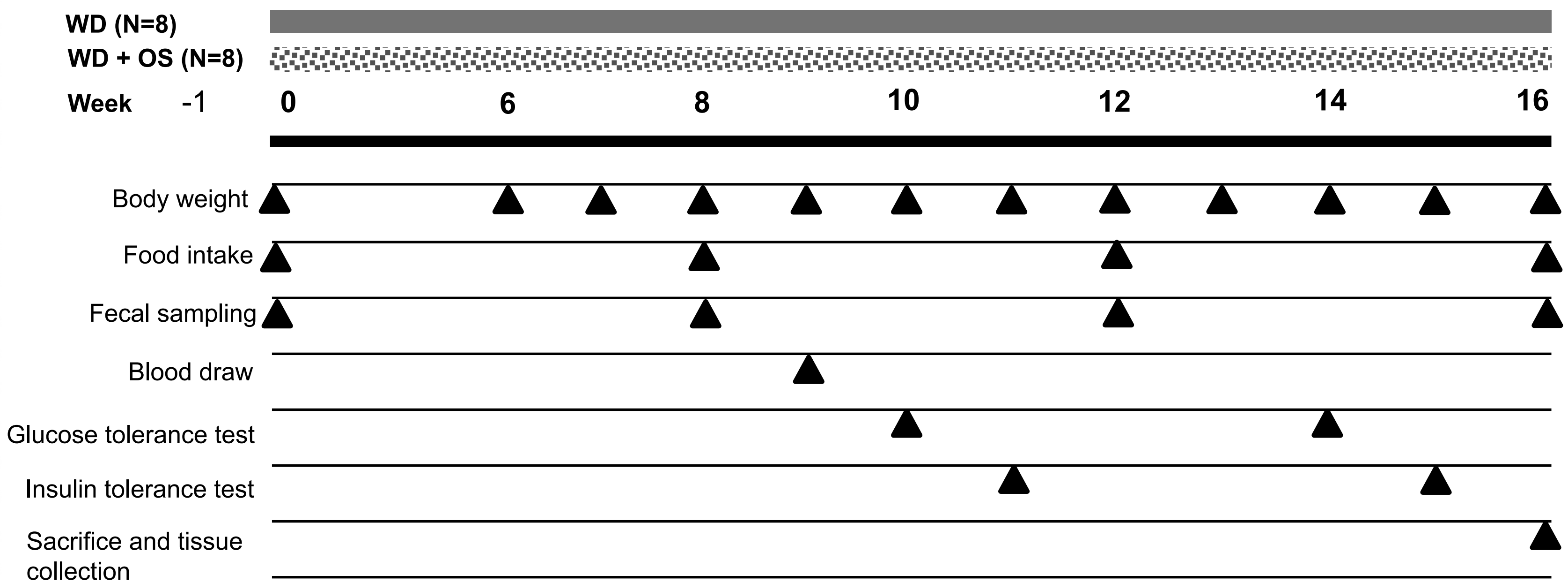
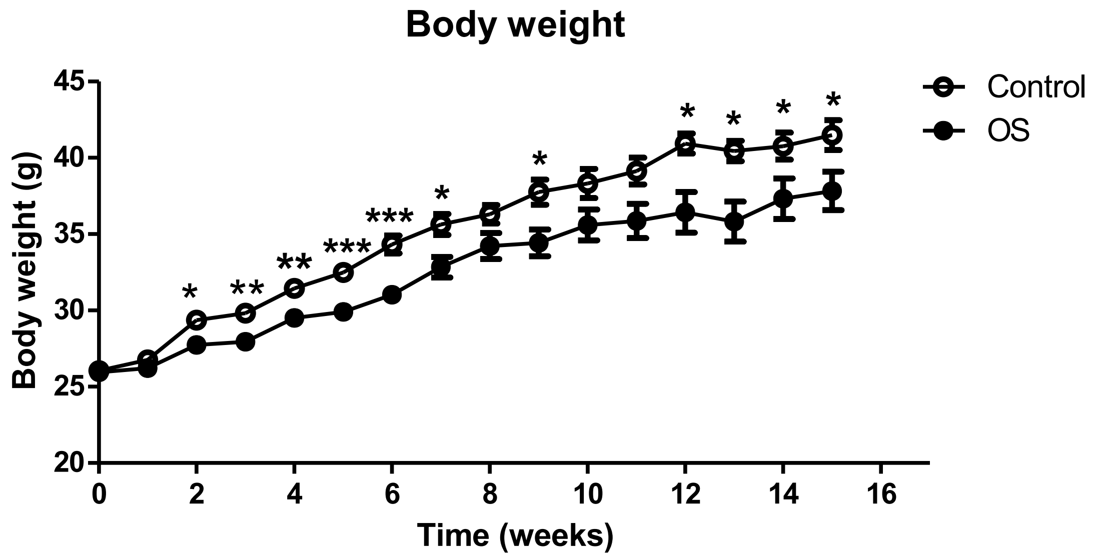
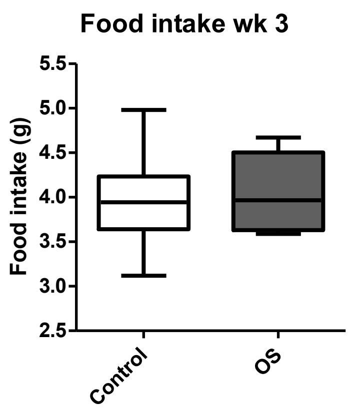
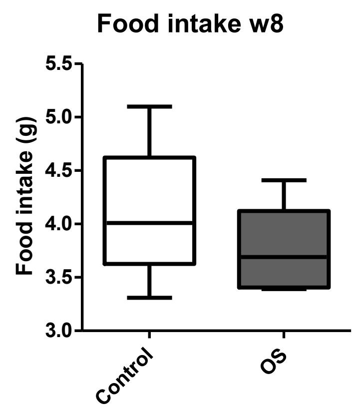
Experimental design

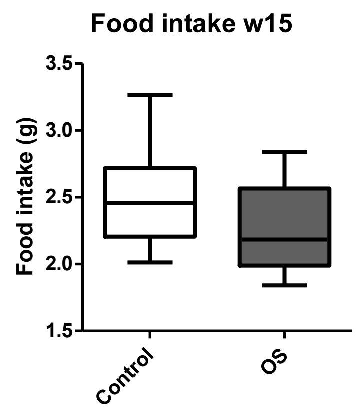


The given oligosaccharides reduces body weight gain









Significant decrease in epididymal and perirenal fat with OS supplementation

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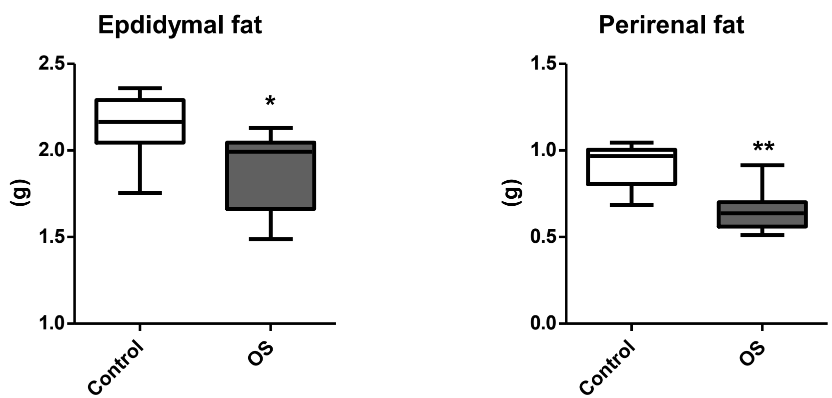

OS supplementation improves insulin tolerance

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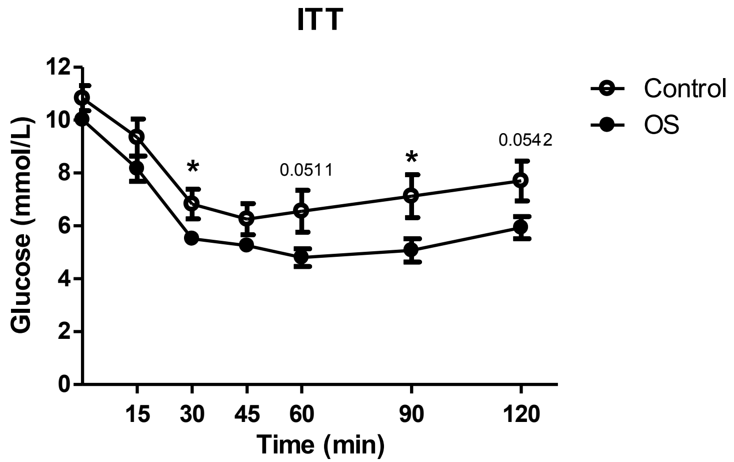

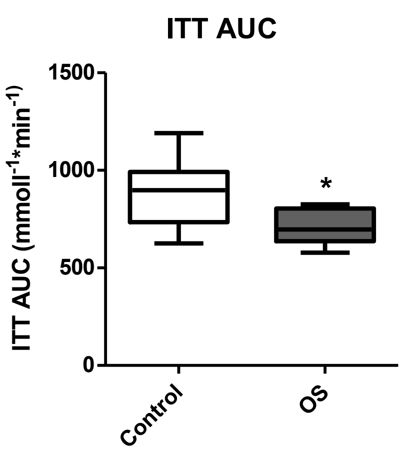

Conclusion

Significant improvement is observed with OS supplementation in body weight gain, fat mass and insulin tolerance

A toolbox for carbohydrate selection

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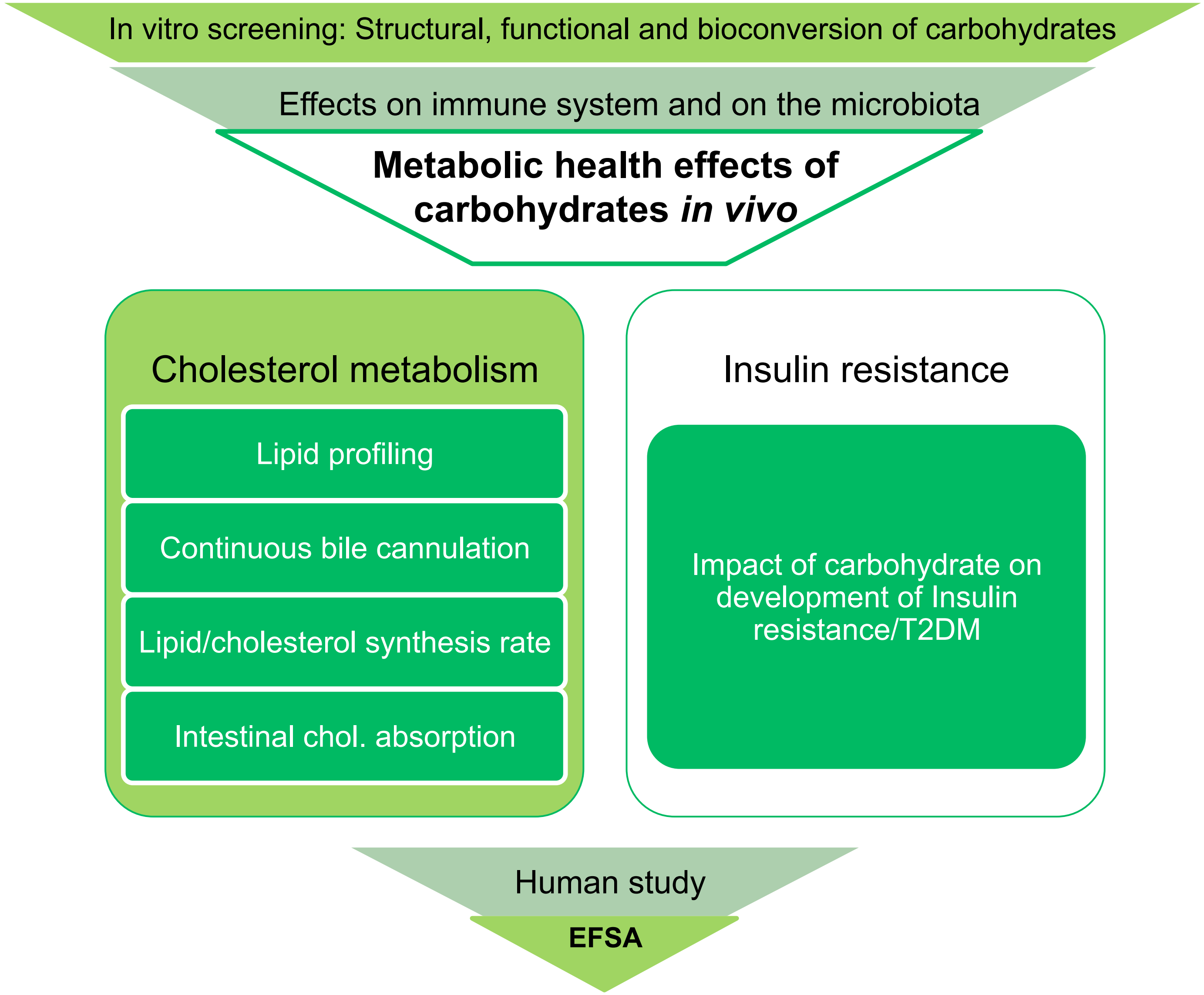

A toolbox for carbohydrate selection

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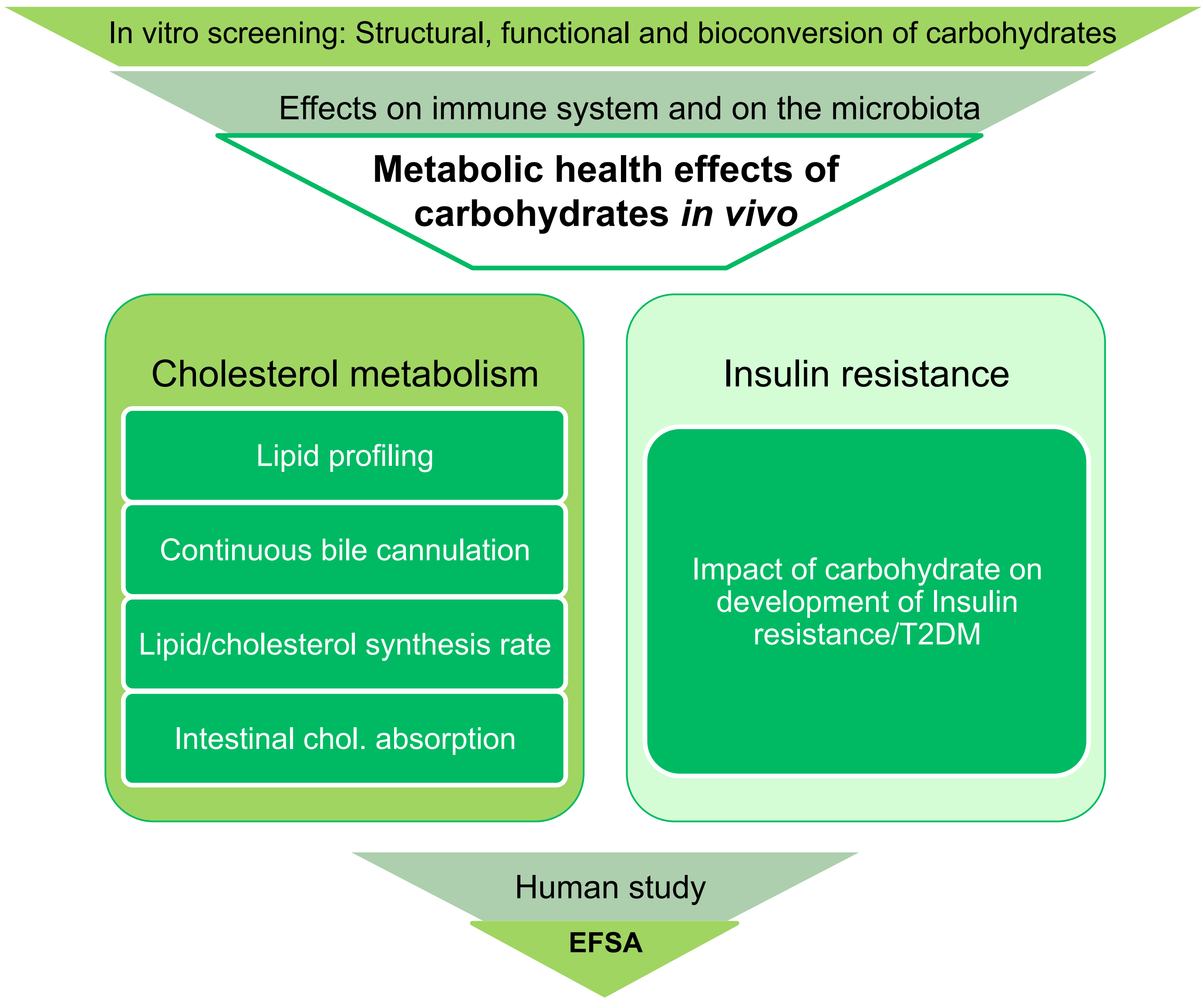

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Thank you for your attention!

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