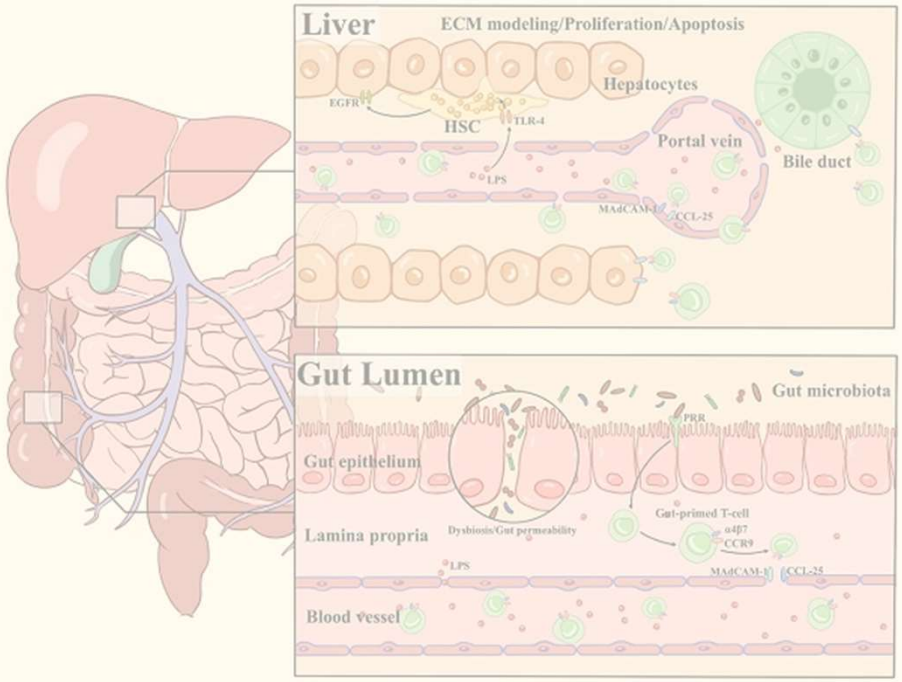
Probiotics and Gut Health:

How a Healthy Gut Microbiome Optimizes Liver Function and Protects the Entire Body



doi:10.7150/ijbs.46405.

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What happens in the gut...

...doesn‘t stay there

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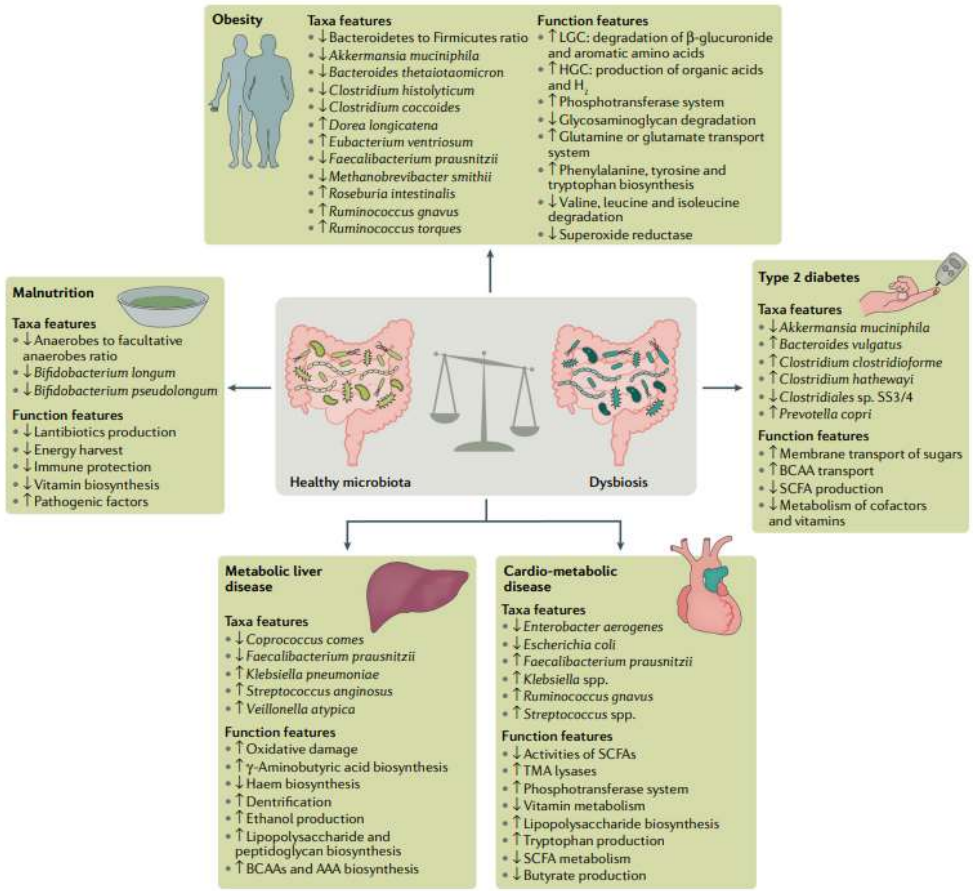
Dysbiosis in the gut, leads to dysbiosis in the body



Fan, Y., Pedersen, O. Gut microbiota in human metabolic health and disease. Nat Rev Microbiol 19, 55–71 (2021). https://doi.org/10.1038/s41579-020-0433-9

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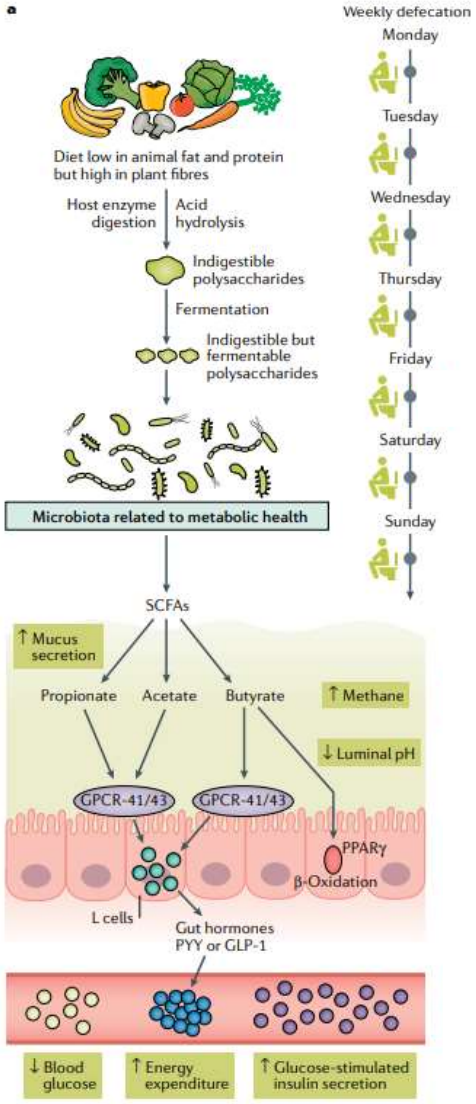
The healthy gut-microbiome



- High diversity
- High microbial richness (many different genes)
- Stable core- microbiome

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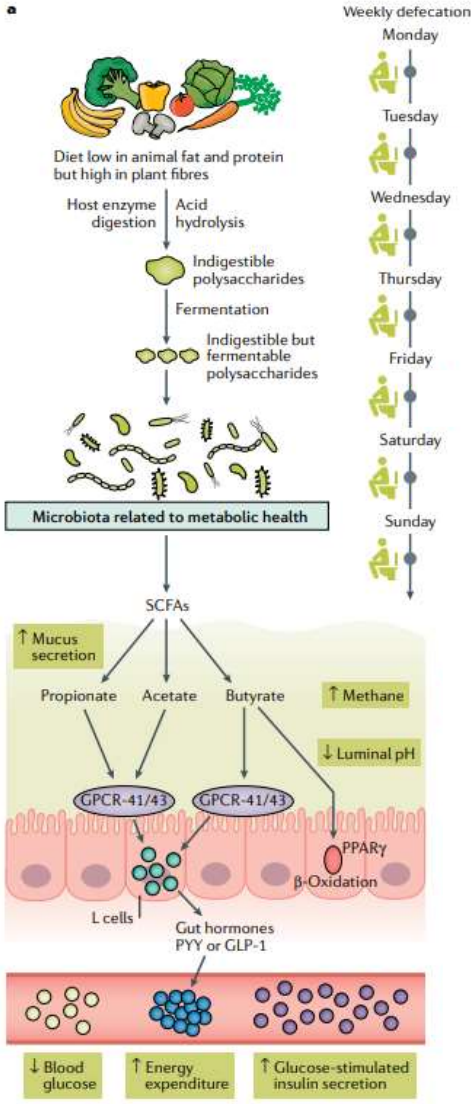
The healthy gut-microbiome

And what it does for us



- Breakdown of glycosaminoglycans
- Production of short-chain fatty acids(**SCFAs**)
- Synthesis of specific lipopolysaccharides
- Biosynthesis of essential amino acids and vitamins

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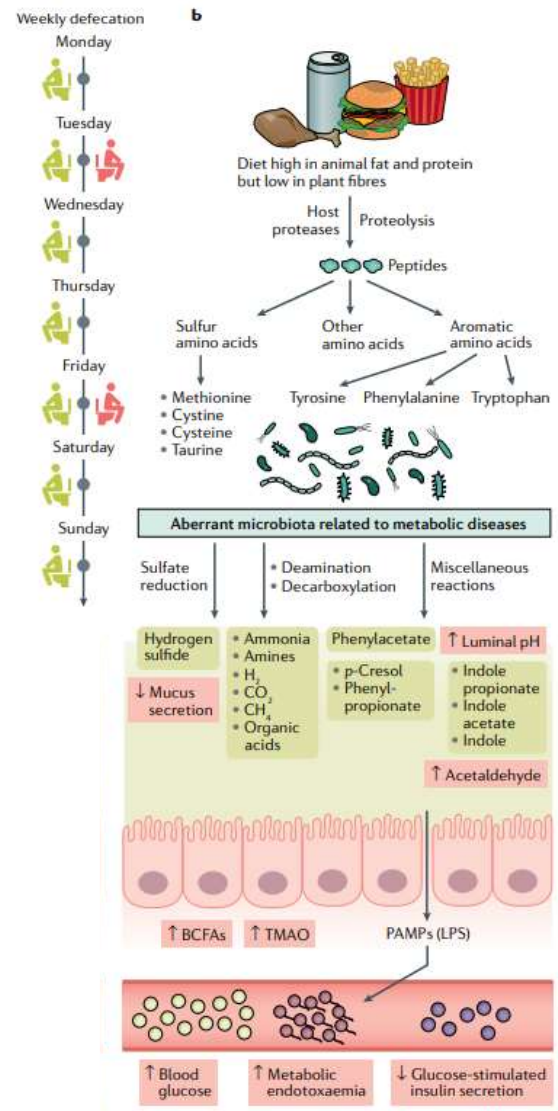
Dysbiosis in the gut-microbiome

Why?

- Poor diet
- Stress
- Illnesses
- Surgical procedures
- medication
- Excessive hygiene
- .....



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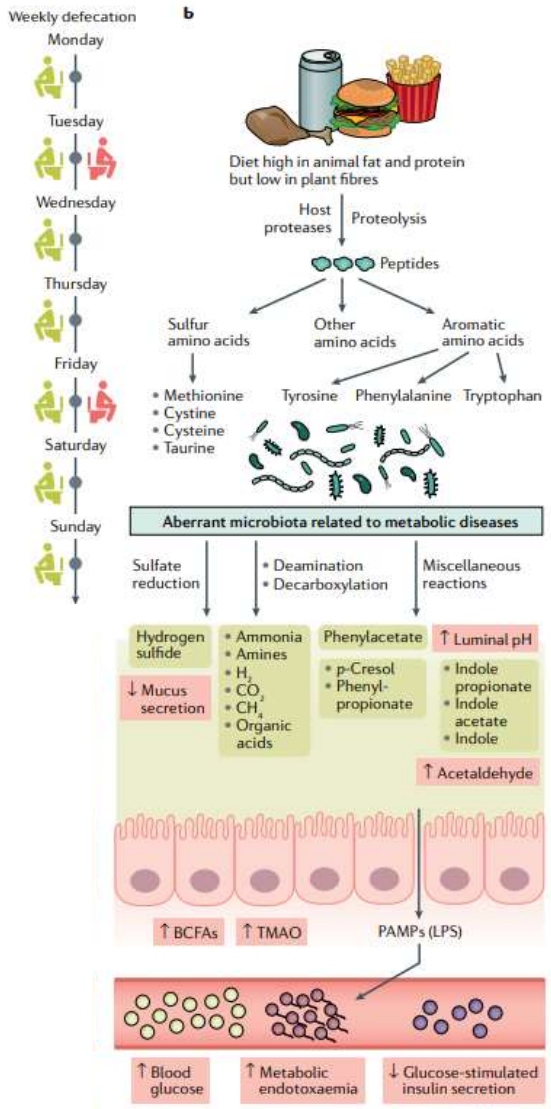
Dysbiosis in the gut-microbiome

What changes?

- Reduction of bacterial diversity
- Loss or reduction of important species such as:
  Bacteroides, Prevotella, Desulfovibrio, Lactobacillus, Oxylobacter,...



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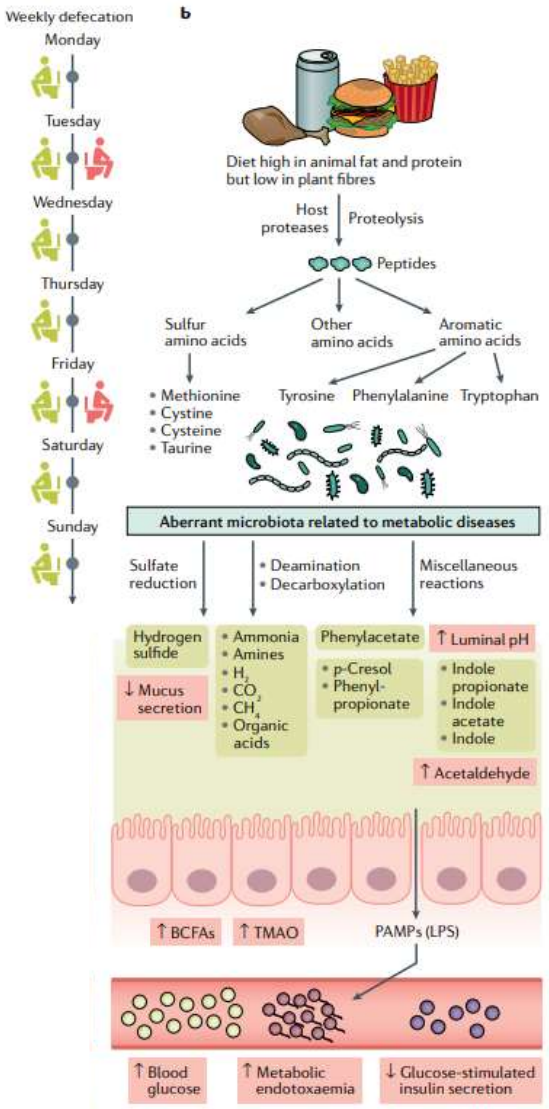
Dysbiosis in the gut-microbiome

What are the consequences?

- Disturbance of the feeling of satiety
- Weight gain
- Inflammation
- Insulin resistence
- Glucose intolerance
- Disorders of fat metabolism
- Atherosclerosis
- ....



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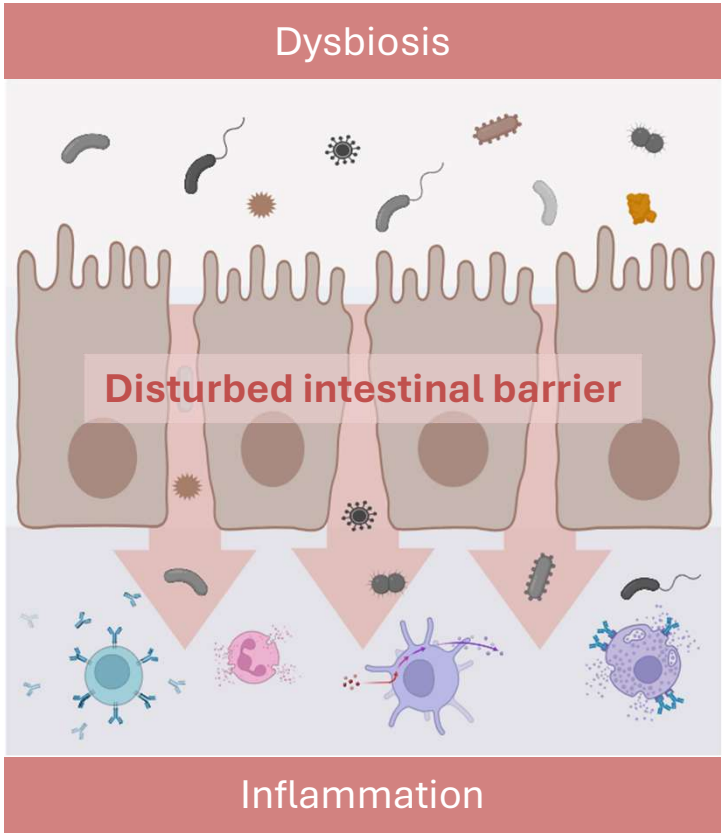
Leaky Gut



1. **Intestinal bacteria out of balance**
   - ↓ Diversity
   - ↓ Health promoting bacteria
   - ↑ potential pathogens

2. **Enhanced permeability of the intestinal fut barrier**
   - ↓ reduction of Tight Junctions
   - ↓ barrier function (Leaky Gut)
   - ↑ Translocation of bacteria & toxins (LPS)

3. **Activation of the immune system**
   - ↑ Immune reaction
   - ↑ proinflammatory Zytokines
   - ↑ local and systemic inflammation

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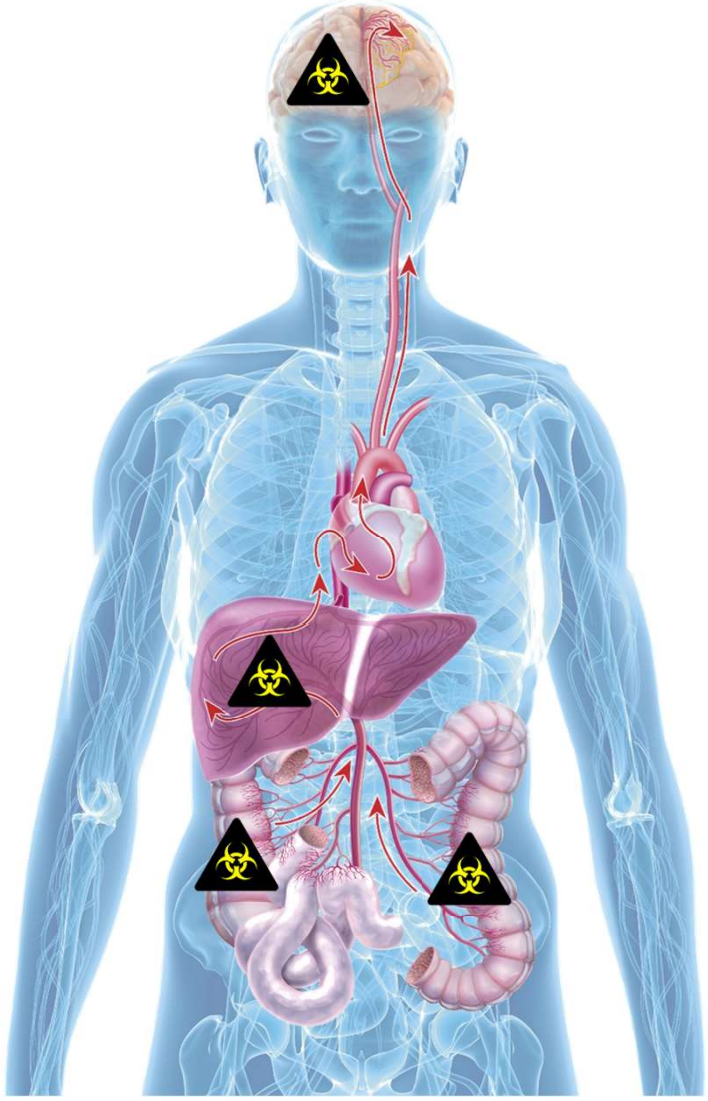
Leaky Gut

- Pathogens → bacterial endotoxins
- Toxic metals: Hg, lead, aluminium, etc.
- Decay products
- Fermented alcohols
- large food molecules (Allergies)
- artificial food ingredients (emulsifiers)

They enter the bloodstream, the nerves, the lymphatic system and thus everywhere!



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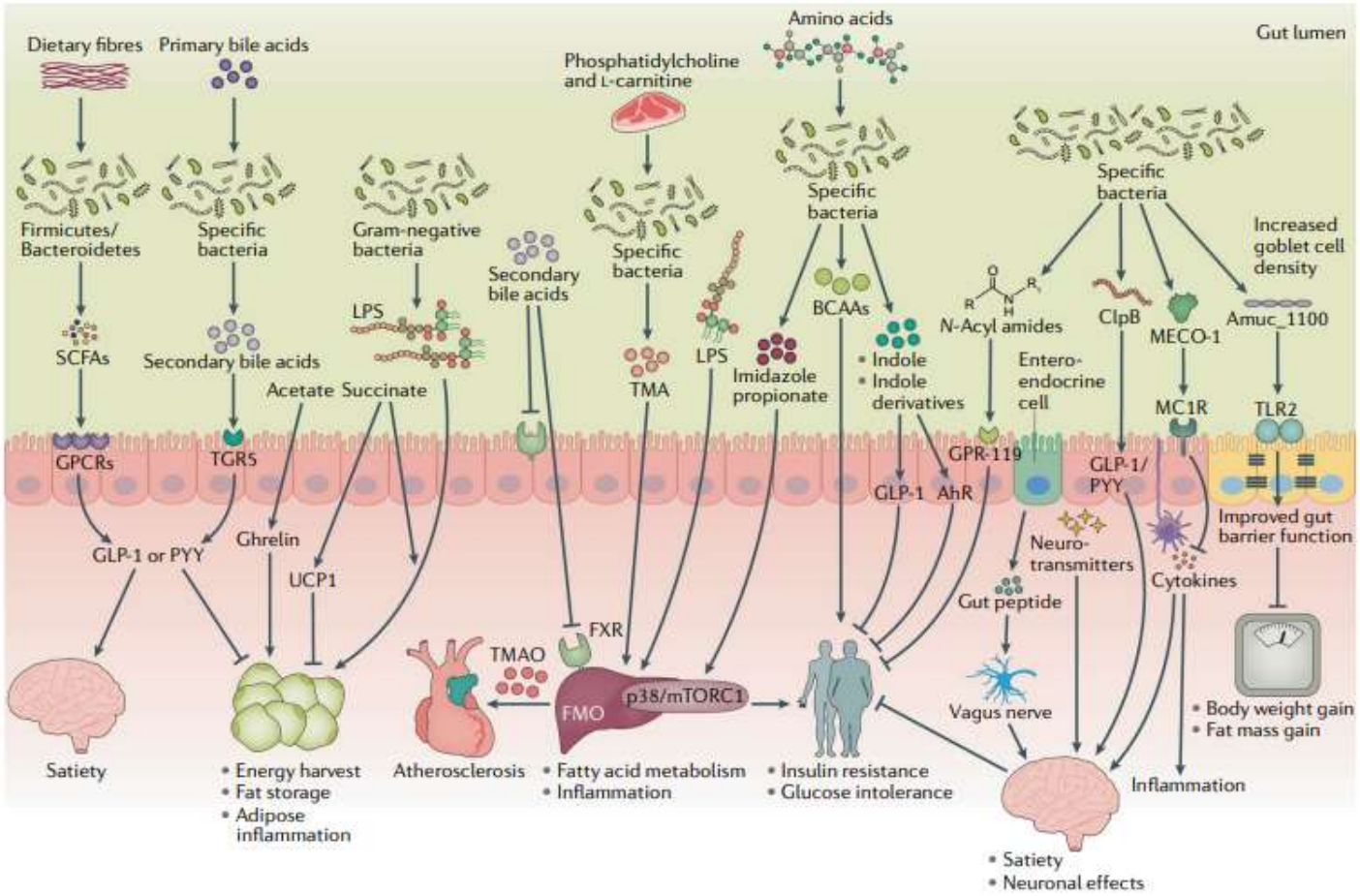
Microbial messenger substances regulate the host metabolism



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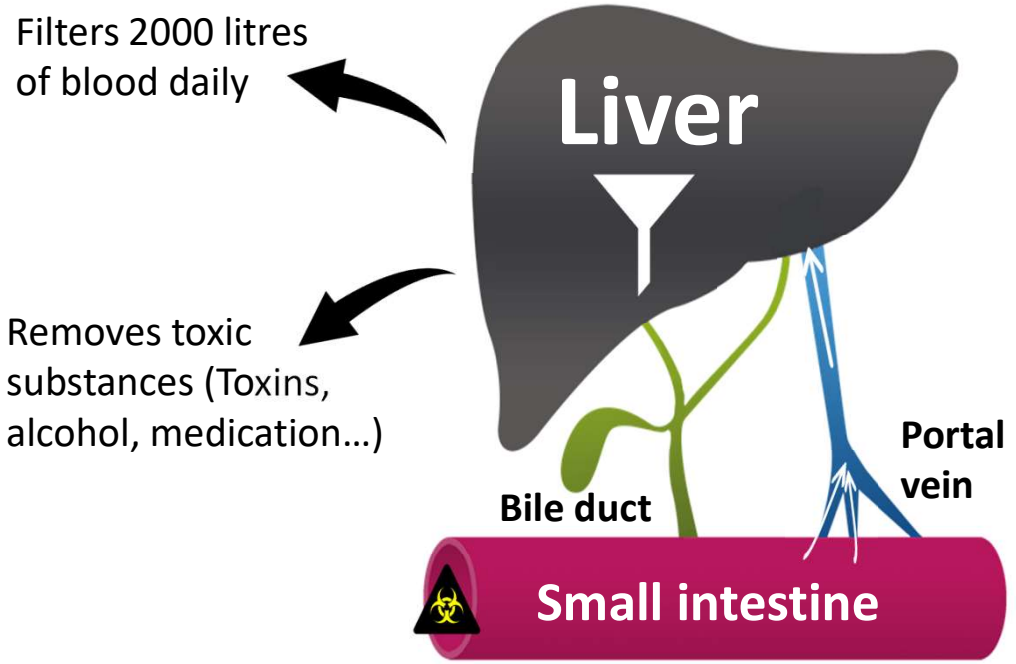
The gut-liver axis

Direct connection between Intestine and liver through the portal vein.

Blood from the small intestine flows first to the liver
→must be purified of all toxic substances



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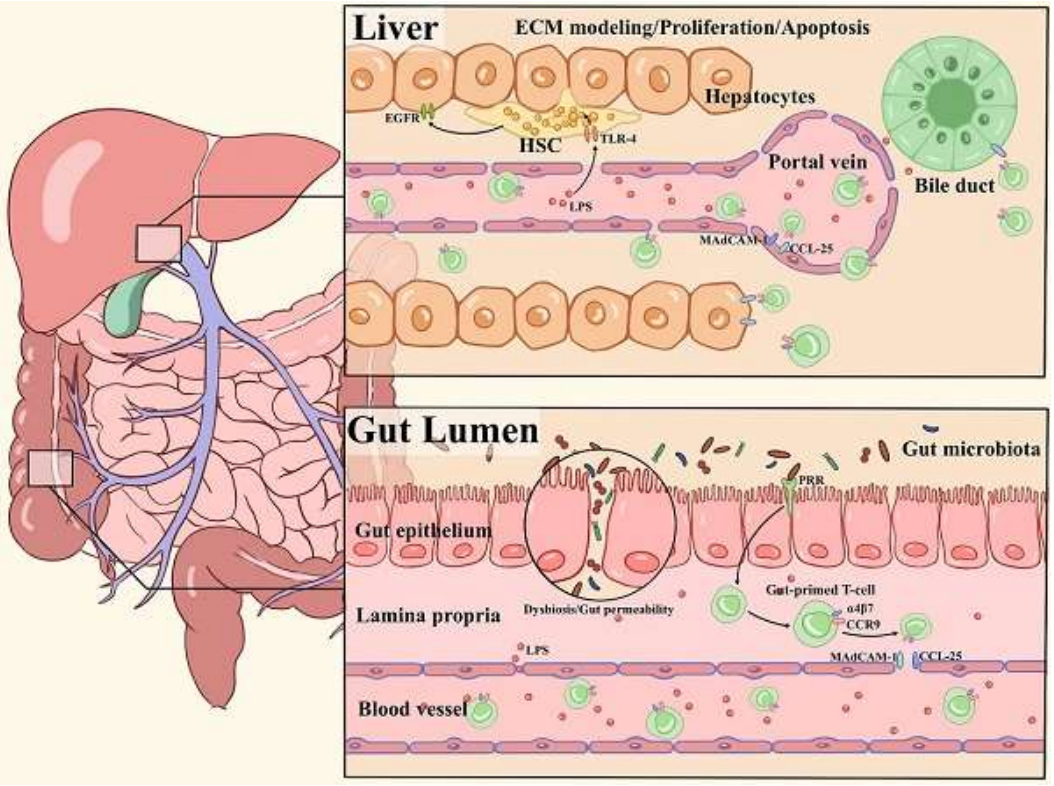
Dysbiosis burdens the liver!



- increased translocation of pathogenic microorganisms and endotoxins (via Leaky gut)
- increased susceptibility to infection
- impaired quality of life
- **Weakened immune system in patients with liver cirrhosis**

Yang, X., Lu, D., Zhuo, J., Lin, Z., Yang, M., Xu, X. (2020). The Gut-liver Axis in Immune Remodeling: New insight into Liver Diseases. International Journal of Biological Sciences, 16(13), 2357-2366. https://doi.org/10.7150/ijbs.46405.

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Liver cirrhosis - liver in “burn out”

- End stage of chronic liver disease that develops over many years.

- Liver tissue transforms into connective tissue (scarring)
  - → death of liver cells, necrosis
  - → Steatosis = liver hardens and shrinks
  - → loss of function

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The positive influence of a medically relevant, indication-specific, multi-species probiotic on compensated liver cirrhosis

nutrients

MDPI

Article

Changes in the Intestinal Microbiome during a Multispecies Probiotic Intervention in Compensated Cirrhosis

Angela Horvath [1,2,*,†], Marija Durdevic [3,4,†], Bettina Leber [5], Katharina di Vora [1], Florian Rainer [1], Elisabeth Krones [1], Philipp Douschan [1], Walter Spindelboeck [1], Franziska Durchschein [1], Gernot Zollner [1], Rudolf E. Stauber [1], Peter Fickert [1], Philipp Stiegler [5] and Vanessa Stadlbauer [1]

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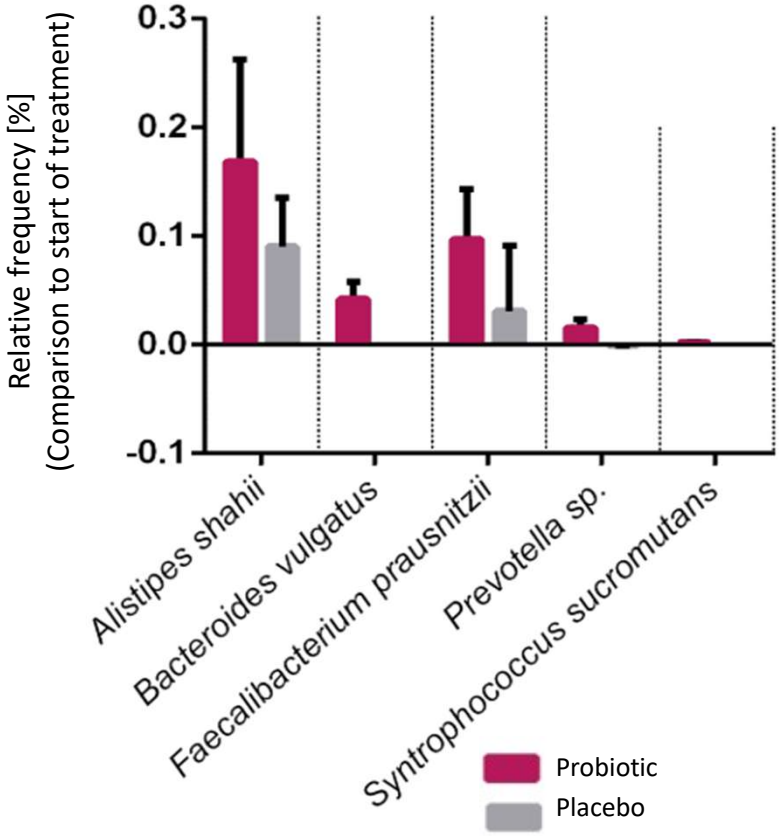
Multi-species probiotic increases the abundance of SCFA-producing bacteria



Faecalibacterium prausnitzii, Alistipes shahii, Bacteroides vulgatus:

- produce SCFA = short-chain fatty acids
- increase in metabolically important bacterial species after 6 months of multi-species proviotic usage
- Duplication of ***F. prausnitzii***
- ***F. prausnitzii*** remains elevated even 6 months after the end of the intervention

A. Horvath et al. “Changes in the Intestinal Microbiome during a Multispecies Probiotic Intervention in Compensated Cirrhosis,” Nutrients, vol. 12, pp. 1874 (2020).

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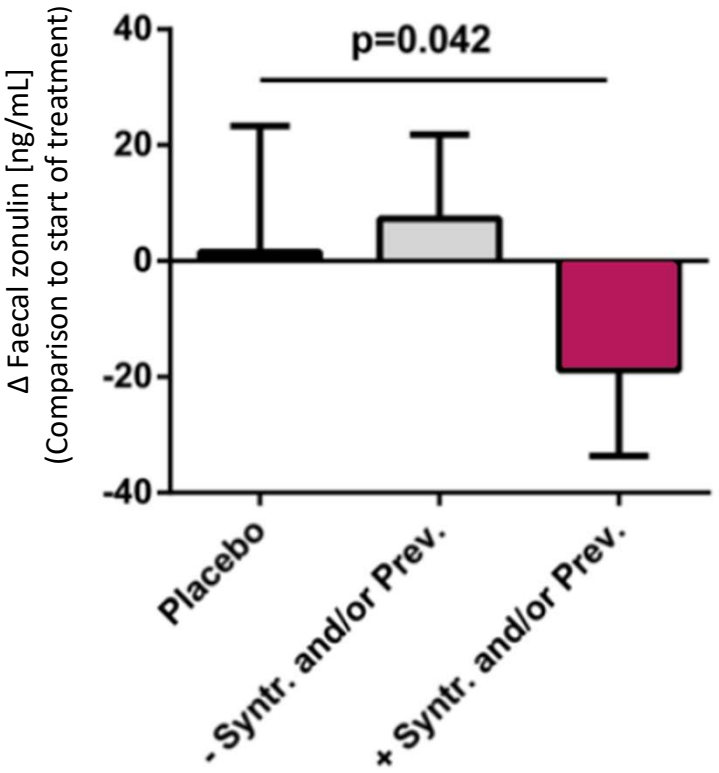
Increase in bacterial taxa by multi-species probiotic is associated with reduction of leaky gut



Zonulin:
parameter for the

- **opening of the tight junctions** and
- associated **leaky gut**

Increase of *Prevotella spp. and Syntrophococcus sucromutans* associated with
Reduction of leaky gut measured using the zonulin value

A. Horvath et al. “Changes in the Intestinal Microbiome during a Multispecies Probiotic Intervention in Compensated Cirrhosis,” Nutrients, vol. 12, pp. 1874 (2020).

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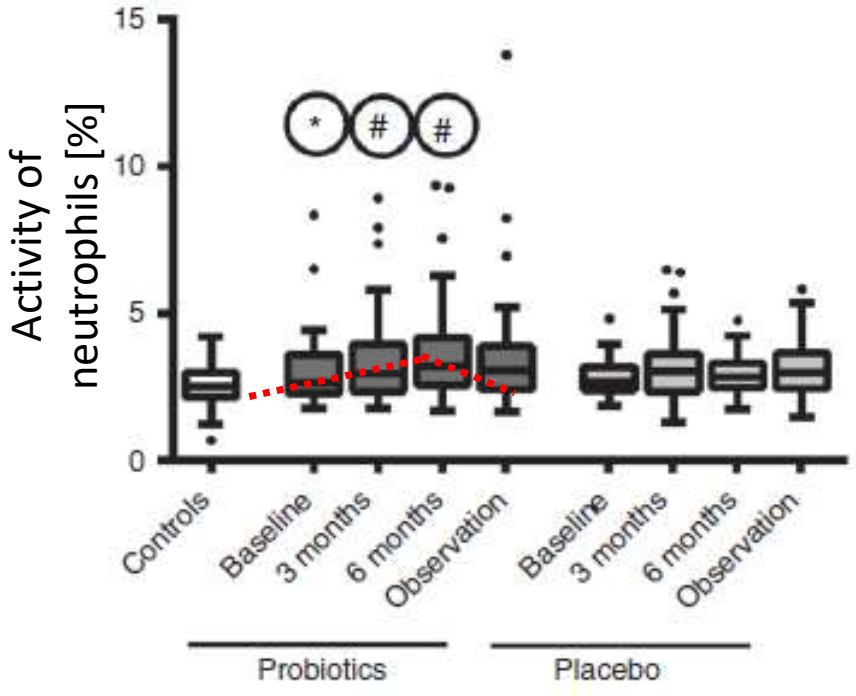
Positive effect of multi-species probiotic on the innate immune system



#= significant increase in neutrophil activity over the course of 6 months

Horvath A, et al. Stadlbauer V, Randomised clinical trial: The effects of a multispecies probiotic vs. placebo on innate immune function, bacterial translocation and gut permeability in patients with cirrhosis. Aliment Pharmacol Ther. 2016;44:926–35.

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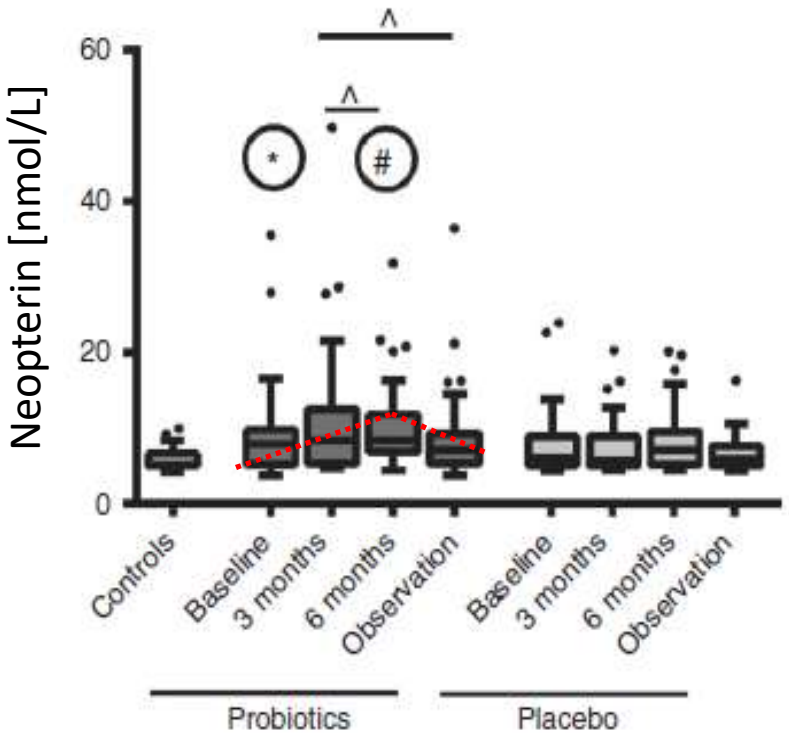
Activation of cellular immune defence by multi-species probiotic



(*) = significant increase compared to placebo

Horvath A, et al. Stadlbauer V, Randomised clinical trial: The effects of a multispecies probiotic vs. placebo on innate immune function, bacterial translocation and gut permeability in patients with cirrhosis. Aliment Pharmacol Ther. 2016;44:926–35.

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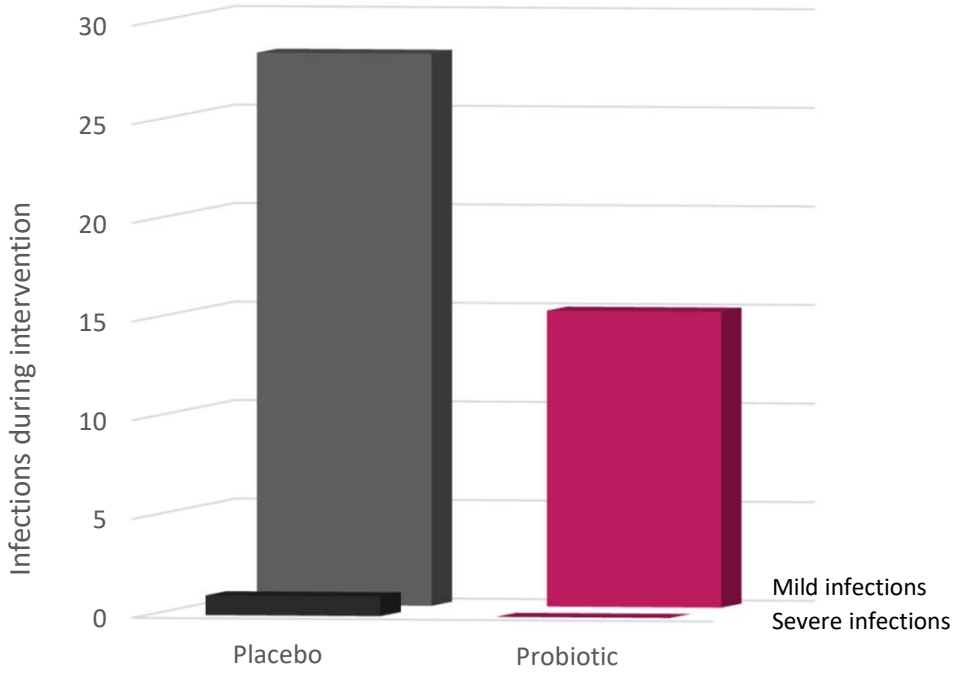
Reduction of infections with multi-species probiotic



Infections

- common complication in cirrhosis
- attributed to significantly impaired immune reactions

Fewer infections when taking multi-species probiotic

Horvath A, et al. Stadlbauer V, Randomised clinical trial: The effects of a multispecies probiotic vs. placebo on innate immune function, bacterial translocation and gut permeability in patients with cirrhosis. Aliment Pharmacol Ther. 2016;44:926–35.

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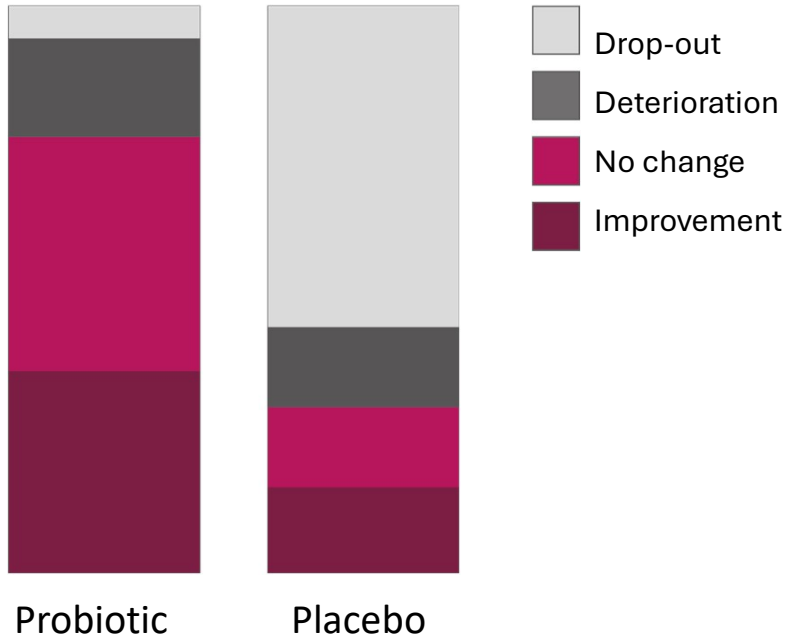
Improved liver function through multi-species probiotic

Patients with significantly reduced liver function (Child-Pugh 7+)



- 38% of the patients improved
- 44% no deterioration
- High drop-out rate in placebo group

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Potential of multi-species probiotic

Relief for the liver - from the gut

for dietary use in liver cirrhosis

- improves liver function parameters:
  Improvement of Child-Pugh and MELD score* in liver cirrhosis
- increases bacterial strains (e.g. *F. prausnitzii*) that produce anti-inflammatory short-chain fatty acids (SCFA)
- increases the activity of the innate and acquired immune response

Child-Pugh Score: Classification of liver cirrhosis in different stages.
MELD score: scoring system to classify the severity of liver disease

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Potential of multi-species probiotic

Relief for the liver - from the gut

- to reduce infections caused by an inadequately functioning immune system
- Reduction of a leaky gut
- noticeable effects after only 3 months due to a reduction in endotoxemia (= high toxin levels in the intestine and subsequently also in the blood due to a disturbed intestinal barrier)

Child-Pugh Score: Klassifikation der Leberzirrhose in unterschiedl. Stadien
MELD-Score: zur Einstufung des Schweregrads von Lebererkrankungen

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Protect your gut-
protect your liver!

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