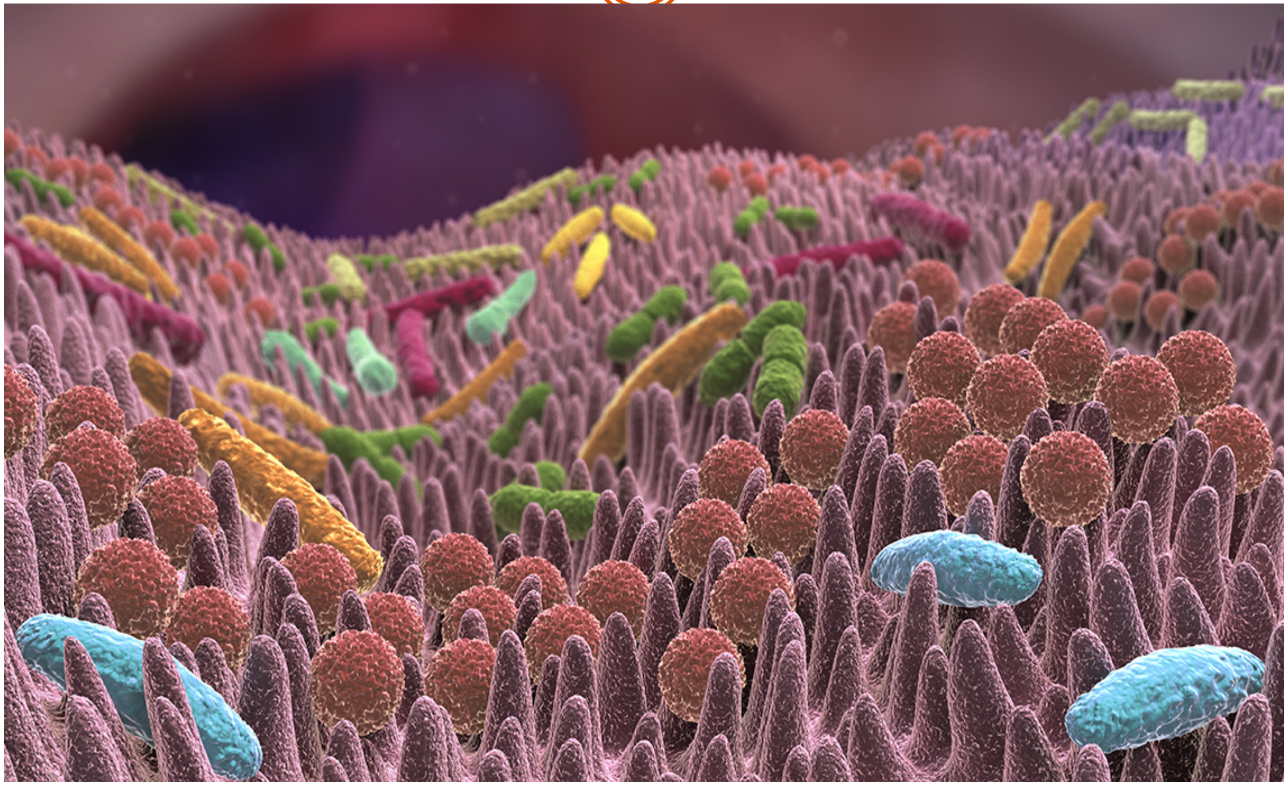
KEV -
Kompetenz in Ernährung und Verdauung
Sonja Nafzger-Schönberg

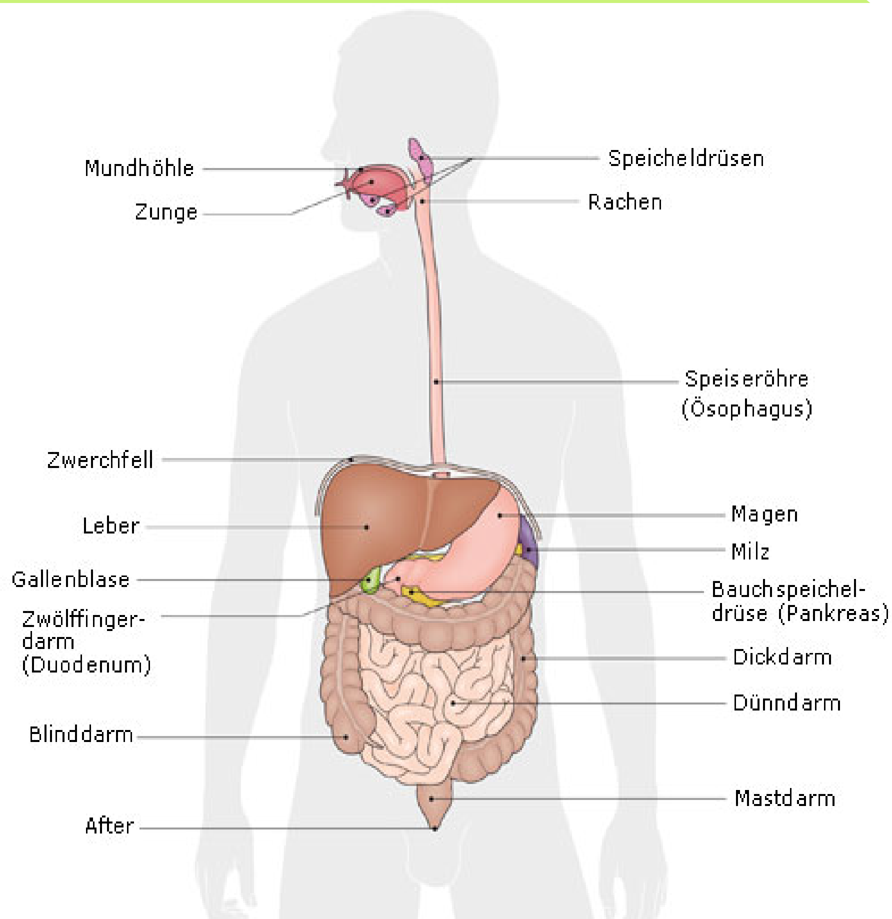
Darmgesundheit, Nahrungsfasern, Präbiotika

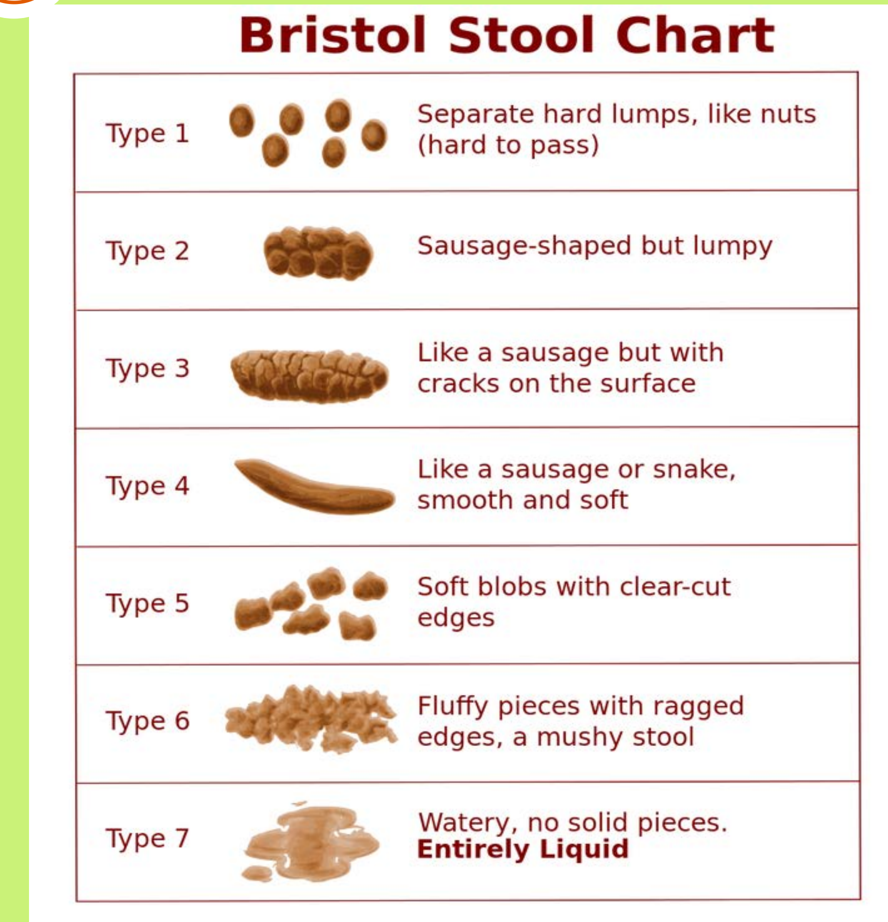


Darmgesundheit, Nahrungsfasern, Präbiotika

- Darmgesundheit – geregelte Verdauung
- Nahrungsfasern – Einteilung heute. Und morgen?
- Nahrungsfasern – Bedeutung für den gesunden Darm

Darmgesundheit – geregelte Verdauung





Lewis SJ, Heaton KW (1997) Stool form scale as a useful guide to intestinal transit time.
Scandinavian Jorunal of Gastroenterology 32: 920–4

Darmgesundheit und Nahrungsfasern

- unterstützen gesundheitsfördernde Prozesse, wie die Senkung des Cholesterinspiegels und/oder die Regulierung des Blutzuckerspiegels

- beeinflussen Konsistenz des Stuhls und regulieren so die Verdauung

- Zufuhrempfehlung: 30g /d bzw.
  Frauen: 16.7g / 1000 kcal
  Männer: 13g / 1000kcal

Scientific Advisory Committee on Nutrition.2015. Carbohydrates and Health.
SGE, 2015 http://www.sge-ssn.ch/ich-und-du/rund-um-lebensmittel/inhaltsstoffe/nahrungsfasern/
DGE/ÖGE/SGE, 2016. DACH Referenzwerte für die Nährstoffzufuhr

Die «Faser-Lücke»

Tabelle 2.13: Durchschnittlicher Verbrauch (Vb) und angenäherter Verzehr (aV) an Fettsäuren, Cholesterin, Alkohol und Nahrungsfasern pro Person und Tag (Durchschnitt 2007/08)

	SFA		MUFA		PUFA		Cholesterin		Alkohol		Nahrungsfasern	
	g Vb	g aV	g Vb	g aV	g Vb	g aV	mg Vb	mg aV	g Vb	g aV	g Vb	g aV
Gemüse	0.1	0.1	0.1	0.1	0.4	0.4	0	0	0.0	0.0	5.6	4.8
Früchte	0.2	0.2	0.4	0.3	0.2	0.2	0	0	0.0	0.0	4.6	3.9
Getreide	0.4	0.4	0.3	0.3	1.0	1.0	0	0	0.0	0.0	8.8	8.8
Kartoffeln	0.0	0.0	0.0	0.0	0.1	0.1	0	0	0.0	0.0	1.7	1.3
Hülsenfrüchte, Nüsse	0.9	0.6	3.8	1.9	1.6	0.9	0	0	0.0	0.0	2.3	1.7
Milch, Milchprodukte	17.2	17.0	6.7	6.6	1.3	1.3	94	94	0.0	0.0	0.0	0.0
Fleisch, Fleischprodukte	6.2	5.9	7.6	7.1	1.7	1.5	104	94	0.0	0.0	0.0	0.0
Fische, Schalentiere	0.2	0.1	0.3	0.2	0.3	0.2	18	12	0.0	0.0	0.0	0.0
Eier	0.9	0.8	1.2	1.1	0.4	0.3	112	99	0.0	0.0	0.0	0.0
Öle, Fette	15.1	12.8	20.5	14.5	18.3	12.2	38	38	0.0	0.0	0.0	0.0
Zucker, Honig	0.0	0.0	0.0	0.0	0.0	0.0	0	0	0.0	0.0	0.1	0.1
Nichtalkoholische Getränke[a]	2.2	2.2	1.2	1.2	0.1	0.1	0	0	0.0	0.0	[illegible]	[illegible]
Gesamtverbrauch (ohne Alkohol)	**43.3**	**40.0**	**42.1**	**33.4**	**25.5**	**18.3**	**367**	**336**	**0.0**	**0.0**	**28.0**	**25.5**
Alkoholische Getränke[b]	0.0	0.0	0.0	0.0	0.0	0.0	0	0	23.2	23.2	0.4	0.4

[a] umfasst die in Tabelle 2.9 aufgeführten Getränkegruppen ausser Mineralwasser

Sechster Schweizer Ernährungsbericht, 2012, BAG

Nahrungsfasern – International verschiedene Definitionen

Table 2.3: Different definitions used for dietary fibre in dietary recommendations

Term	Definition
Non-starch polysaccharides – UK, 1991	Non-α-glucan polysaccharides: cellulose and non-cellulose polysaccharides (e.g. pectins, glucans, arabinogalactans, arabinoxylans, gums, and mucilages).
Dietary fibre – WHO, 2006	Intrinsic plant cell wall polysaccharides, i.e. non-starch polysaccharides
Total dietary fibre – US, 2005	Non-digestible carbohydrates and lignin that are intrinsic and intact in plants, and isolated, non-digestible carbohydrate components that have beneficial physiological effects in humans, with a DP of three or more. It was noted that the methodologies used at that time chemically defined total dietary fibre as non-starch polysaccharides, some resistant starches, lignin and some inulin, but did not include non-digestible oligosaccharides.
Dietary fibre – Codex, 2008	Carbohydrate polymers with ten or more monomeric units, which are not hydrolysed by endogenous enzymes in small intestine of human beings plus lignin and/or other compounds when associated with polysaccharides in the plant cell walls. The decision on whether to include carbohydrates from three to nine monomeric units in the definition of dietary fibre was left to national authorities.
Dietary fibre – EFSA, 2010	Non-starch polysaccharides, all resistant starches, all non-digestible oligosaccharides with three or more monomeric units and other non-digestible, but quantitatively minor components that are associated with the dietary fibre polysaccharides, especially lignin.

Scientific Advisory Committee on Nutrition.2015. Carbohydrates and Health.

Definition Nahrungsfasern – Europäischer Konsens

- Alle unverdaulichen Kohlenhydrate:
  - Alle Nicht-Stärke-Polysaccharide
  - Alle Resistenten Stärken
  - Alle unverdaulichen Oligosaccharide mit >3 Monomeren
- Lignin

efsa
European Food Safety Authority

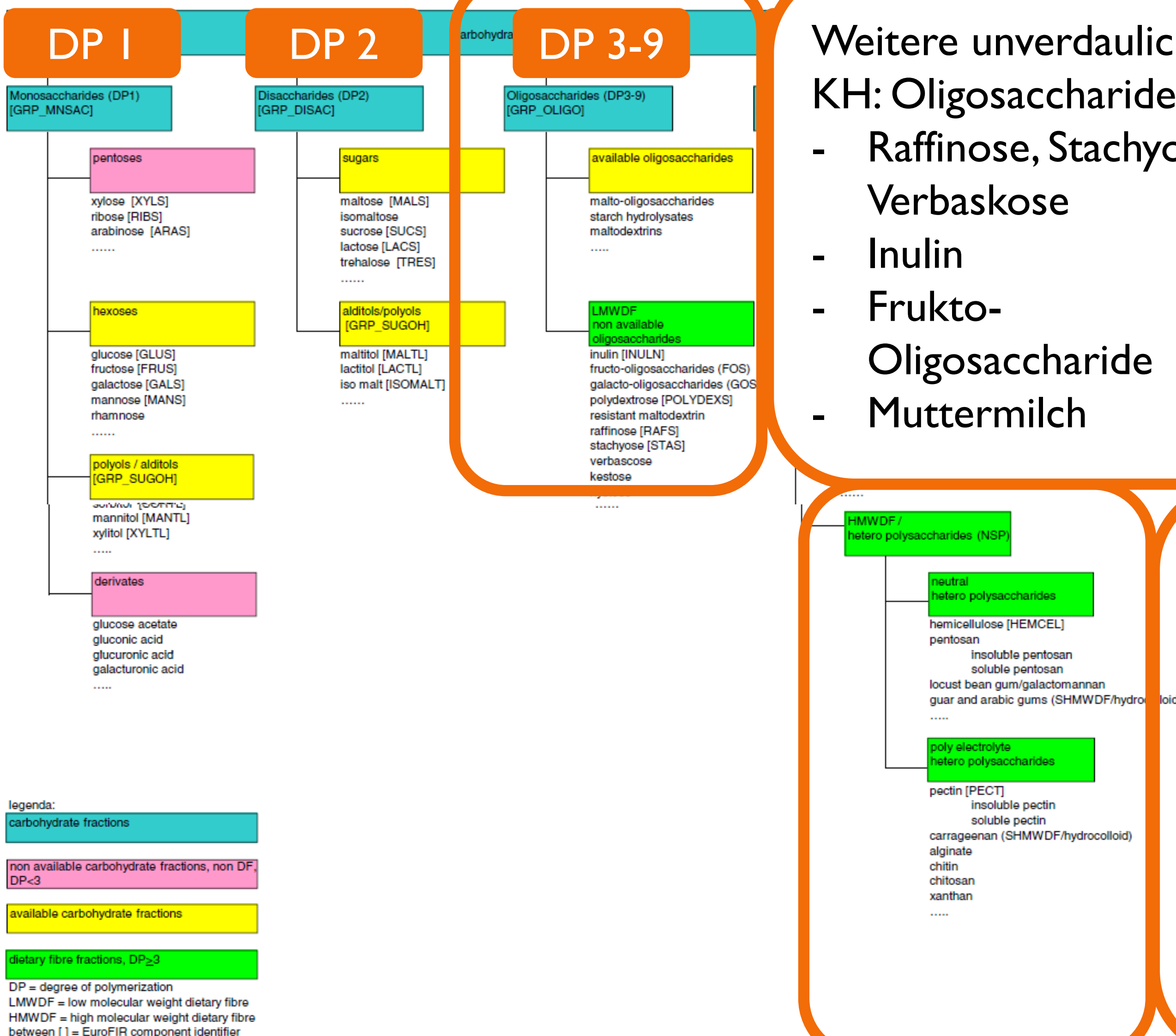
In Form
- natürlich vorkommender Nahrungsfasern
- von Kohlenhydratpolymeren, welche aus Rohmaterial von natürlichen Lebensmitteln durch physikalische, enzymatische oder chemische Prozesse gewonnen wurden
- synthetischer Polymere

und für welche in jedem Fall wissenschaftlich nachgewiesen werden kann, dass sie günstige, physiologische Effekte erfüllen.

EFSA. 2010. Scientific Opinion on Dietary Reference Valueas for carbohydrates and dietary fibre. EFSA Journal 8, 1462.

Ernährungsberater/in SVDE
Schweizer Gesundheitsberuf

S. Westenbrink et al. / Food Chemistry 140 (2013) 562–567



Weitere unverdauliche KH: Oligosaccharide

- Raffinose, Stachyose, Verbaskose
- Inulin
- Frukto-Oligosaccharide
- Muttermilch

«Klassische Nahrungsfasern»: Nicht-Stärke-Polysaccharide (NSP)

- Zellulose
- Hemizellulosen und Pentosane
- Pflanzengummis und Speicher-Polysaccharide

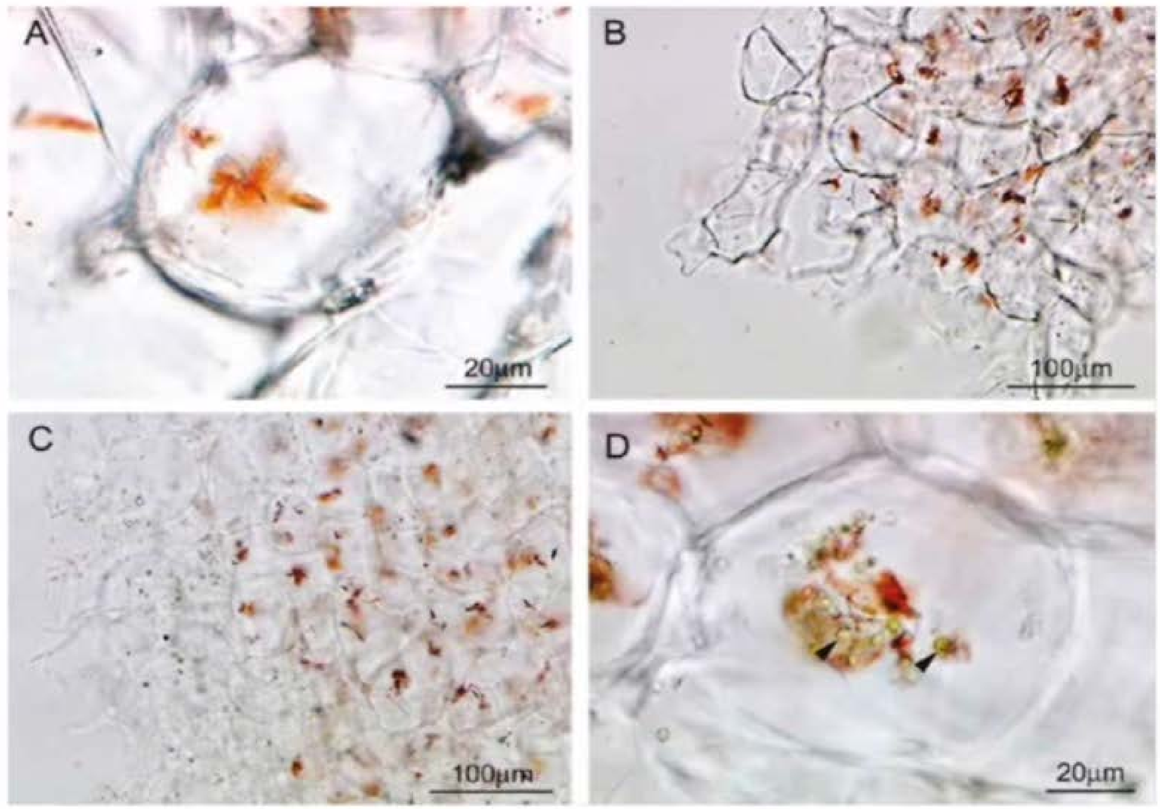
Fig. 1. Schematic overview of carbohydrates including dietary fibre fractions with EuroFIR component identifier.

S. Westenbrink et al. , Dietary fibre: Challenges in production and use of food composition data, Food Chemistry 140 (2013) 562–567
Scientific Advisory Committee on Nutrition. 2015. Carbohydrates and Health.

Nahrungsfasern - unverdauliche Kohlenhydrate

A – undigested raw carrot shred

B/C/D – raw carrot recovered from ileostomy subjects after 8-10h digestion time



Tydeman et al, *J Agric Food Chem*, 58, 9855-9860 (2010)

Gidley, 2013, Hydrocolloids in the digestive tract and related health implications, Current Opinion in Colloid & Interface Science 18 (2013) 371– 378

Prof. Mike Gidley QAAFI, Dietary fibre polysaccharides in the digestive tract: physical properties and nutrition implications, presented: 20.04.2015 QAAFI Science Seminar

Nahrungsfasern – löslich vs. unlöslich

sge Schweizerische Gesellschaft für Ernährung
ssn Société Suisse de Nutrition
ssn Società Svizzera di Nutrizione

Nahrungsfasern

Aufbau

- Nahrungsfasern bestehen hauptsächlich aus unterschiedlich langkettigen Polysacchariden (Vielfachzucker).
- Nahrungsfasern sind je nach Kettenstruktur löslich oder unlöslich.

Lösliche Nahrungsfasern

- Pektin, resistente Stärke, Inulin, Oligofructose, Pflanzengummis, Schleimstoffe, Betaglukane, Gelstoffe.
- Bilden in Kontakt mit Wasser eine gelartige Verbindung, haben aber nur eine geringe Wasserbindungskapazität.
- Werden von den Dickdarmbakterien weitgehend abgebaut, z.B. zu kurzkettigen Fettsäuren.

Unlösliche Nahrungsfasern

- Cellulose, Hemicellulose, Lignin
- Quellen in Kontakt mit Wasser stark auf (hohe Wasserbindungskapazität).
- Werden von den Dickdarmbakterien kaum abgebaut und grösstenteils mit dem Stuhl unverdaut wieder ausgeschieden.

- Unterscheidung löslich / unlöslich erfolgt im Labor
- pH-Wert der Lösung ist relevant, ob sich ein NSP eher löslich oder unlöslich verhält
- Fermentierbarkeit unlöslicher Fasern stärker als angenommen
- Pflanzenzellen enthalten beide Faserarten

FAO (2003) *Food energy – methods of analysis and conversion factors. Report of a Technical Workshop* no. 77. Rome: FAO

Cummings JH & Stephen AM (2007) Carbohydrate terminology and classification. *European Journal of Clinical Nutrition* 61 Suppl 1, S5-18.

Nahrungsfasern – beyond solubility

	Wasser-löslichkeit	Gelbildung	Viskosität / Quellfähigkeit	Fermentier-barkeit
Pektin	+	+++	- / +++	100%
Beta Glukan	+	+++	++++	100%
Guar	+	+++	+ / ++++	100%
Psyllium	+	+++	++++	0-70%
Hemizellulose A	++	+	++	50-70%
Inulin	+	++	- / +	100%
Resistente Stärke	-	(+)	+	100%
Hemizellulose B	(+)	+	(+)	50-70%
Zellulose	-	-	(+)	0-30%
Lignin	-	-	-	0%

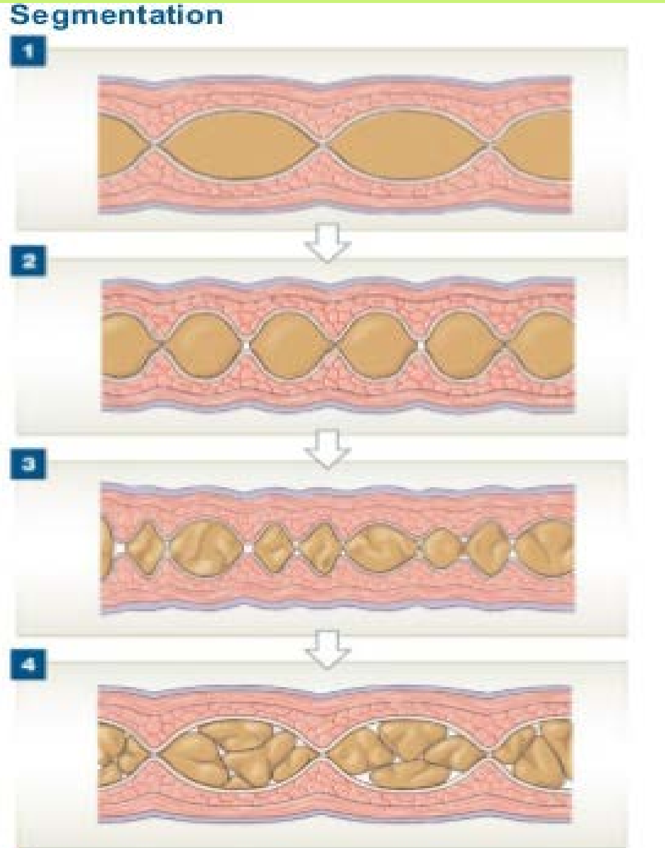
Kumar in Lomer, 2015. Fibre in gastrointestinal health. Advanced Nutrition and Dietetics in Gastroenterology. Wiley Blackwell, 57-69.
Trepel, 2004. Ballaststoffe: mehr als ein Diätmittel. Wiener Klinische Wochenschrift, 116/15-16: 511-522.
McRorie, 2015, Evidence-Based Approach to fiber Supplementation, Part 1

Annahmen zur Physiologie von Nahrungsfasern

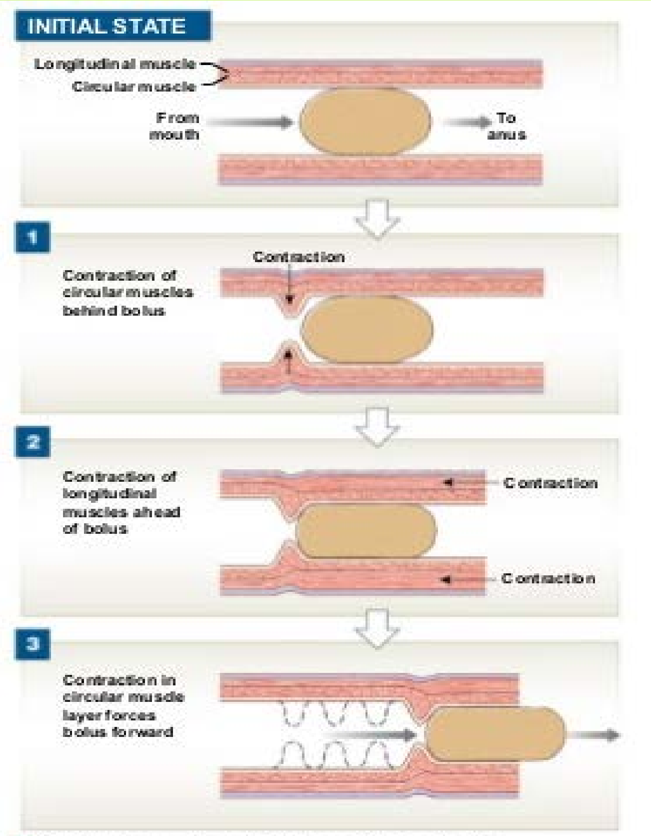
- Alle Nahrungsfasern begünstigen die Laxation
- Unlösliche Nahrungsfasern haben eine hohe Wasserbindungskapazität
- Lösliche Nahrungsfasern erhöhen die Laxation durch Steigerung der Biomasse
- Nahrungsfasern, die die Laxation erhöhen, führen in Überdosen zu Diarrhö
- Nahrungsfasern fördern die Motilität und begünstigen dadurch die Laxation

McRorie, 2016, Understanding the Physics of Functional Fibers in the Gastrointestinal tract

Verdauung im Kolon – Segmentation und Peristaltik



Segmentation movements primarily involve the circular muscle layers. These activities churn and mix the contents of the digestive tract, but do not produce net movement in a particular direction.



Peristalsis propels materials along the length of the digestive tract by coordinated contractions of the circular and longitudinal layers.

McRorie, 2016, Understanding the Physics of Functional Fibers in the Gastrointestinal tract

2012, Pearson Education, Inc. https://www.slideshare.net/TheSlaps/ch-25lecturepresentation-39270752

TABLE Clinically Demonstrated Health Benefits Associated With Common Fiber Supplements

	No Water-Holding Capacity			Water-Holding Capacity			
	Insoluble	Soluble, Nonviscous		Soluble Viscous	Soluble Viscous/Gel Forming		
	Wheat Bran	Wheat Dextrin	Inulin	Methylcellulose	Partially Hydrolyzed Guar Gum	β-Glucan	Psyllium
Source	Wheat	Heat/acid treated wheat	Chicory root	Chemically treated wood pulp	Guar beans	Oats, barley	Seed husk, *Plantago ovata*
Degree of fermentation	Poorly fermented	Readily fermented	Readily fermented	Nonfermented	Readily fermented	Readily fermented	Nonfermented
Cholesterol lowering					+/−[a]	+[b]	+
Improved glycemic control					+/−[a]	+[b]	+
Satiety						+[b]	+
Weight loss							+/−[c]
Constipation/ stool softener	+[d]			+/−[e]			+
Diarrhea/stool normalizer							+
Irritable bowel syndrome							+[f]

Blank cells indicate a totality of negative clinical data or a lack of clinical data supporting the health benefit.

[a]The efficacy of partially hydrolyzed guar gum depends on the degree to which it has been hydrolyzed. If a marketed product has little/no viscosity when mixed with water (as described above), then it will not exhibit significant gel-dependent health benefits.

[b]Oat products are typically marketed in fiber bars or cereals, requiring pressure and/or heat to make the final product, potentially reducing gel-forming capacity.

[c]The criteria for "clinically demonstrated" was publication of at least 2 well-controlled clinical studies. Sustained weight loss for psyllium was assessed in only 1 clinical study,[60] so a designation of +/− was deemed most appropriate.

[d]Insoluble fiber can have a significant laxative effect if the particle size is sufficiently large/coarse.

[e]Methylcellulose has an over-the-counter (OTC) indication for treatment of occasional constipation, but the American College of Gastroenterology determined that methylcelluose had insufficient clinical data to recommend it for treatment of chronic constipation.[42]

[f]A recent comprehensive review published in the *American Journal of Gastroenterology* determined that "When fiber is recommended for functional bowel disease, us supplement such as ispaghula/psyllium is best supported by the available evidence."[9]

McRorie, 2015, Evidence-Based Approach to fiber Supplementation, Part 2

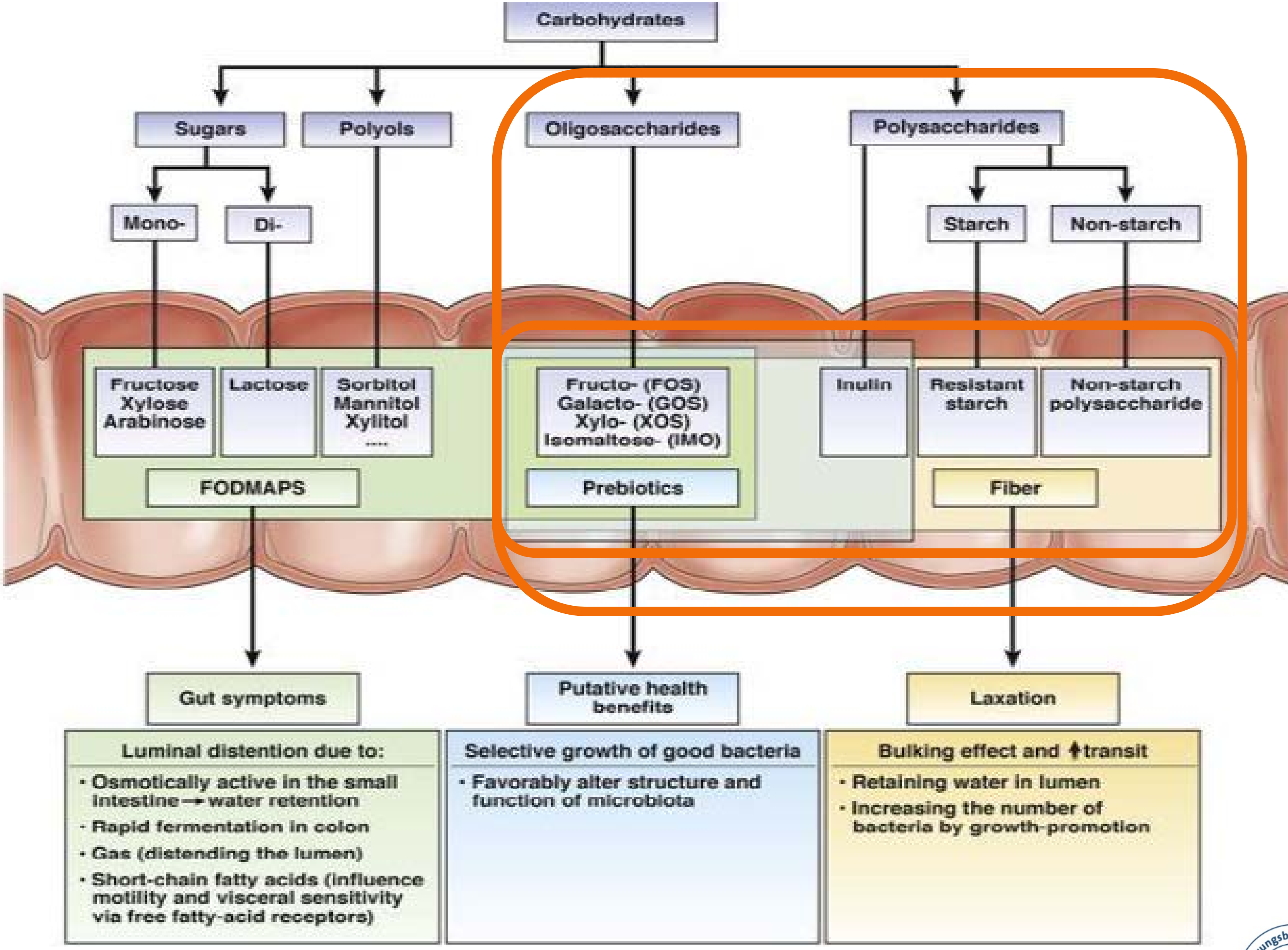
Nahrungsfasersupplemente

Psyllium

- Laxative Eigenschaften vermutlich mit geringfügig fermentierbarer Arabinoxylanfraktion erklärbar, die im Colon intakt bleibt
- Mögliche Effekte, die Laxation begünstigen:
  - Höheren Wassergehalt = Optimierung der Stuhlkonsistenz, Gelbildung, Erhöhung des Stuhlgewichts
  - Erhöhung der Peristaltik = höhere Stuhlfrequenz, kürzere Transitzeit
  - In Kombination mit Weizenkleie möglicherweise weitere Zunahme des Stuhlgewichts

- Weichere, leicht auszuscheidende Stühle = Schmerzreduktion
- Dosierungsempfehlung: Kleine Dosen einführen, langsam steigern
- z.B. 1. Woche: 3g/d , sehr langsam steigern bis ca. 10-19g / Tag

McRorie, 2016, Understanding the Physics of Functional Fibers in the Gastrointestinal tract



Gibson et.al. 2015. Food compounents in irritable bowel syndrome. Gastroenterology, Vol. 148, Is 6, 1158-1174.e4

Darmgesundheit – Präbiotika

- a substrate that is selectively utilized by host microorganisms conferring a health benefit

Box 1 | Main conclusions of the consensus panel regarding prebiotics

- The definition of a prebiotic has been modified to 'a substrate that is selectively utilized by host microorganisms conferring a health benefit'
- Although most current prebiotics are administered orally, they can also be administered directly to other microbially colonized body sites, such as the vaginal tract and skin
- Health effects of prebiotics are evolving but currently include benefits to the gastrointestinal tract (for example, inhibition of pathogens, immune stimulation), cardiometabolism (for example, reduction in blood lipid levels, effects upon insulin resistance), mental health (for example, metabolites that influence brain function, energy and cognition) and bone (for example, mineral bioavailability), among others
- We acknowledge that definitive proof of causality is difficult to provide. However, a human or animal study showing a change in heath markers or symptoms after a specific influence on the microbial population (that is, a blinded placebo-controlled trial with appropriate exclusion and/or inclusion criteria) then it is reasonable to assume that the two are causally related
- Currently established prebiotics are carbohydrate-based, but other substances such as polyphenols and polyunsaturated fatty acids converted to respective conjugated fatty acids might fit the updated definition assuming convincing weight of evidence in the target host
- The beneficial effect(s) of a prebiotic on health must be confirmed in the target animal for its intended use and mediated through the microbiota

Gibson et.al., 2017, The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on the definition and scope of prebiotics

Nicht alle Präbiotika sind Nahrungsfasern! Nicht alle Nahrungsfasern sind Präbiotika!

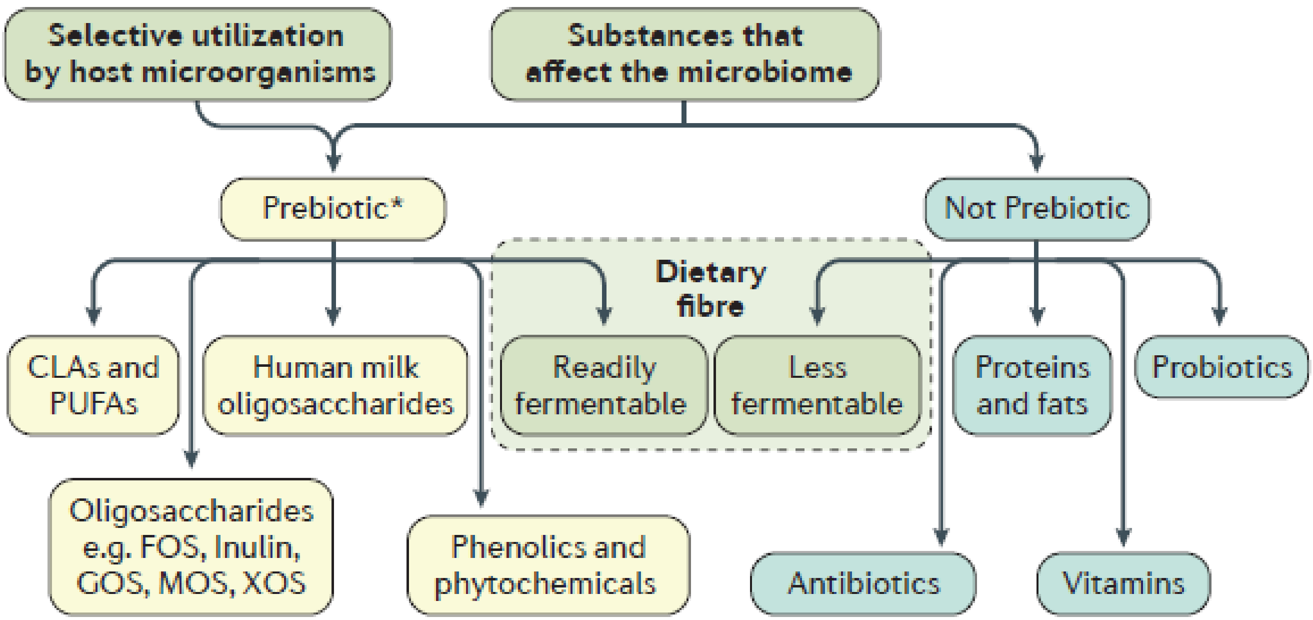


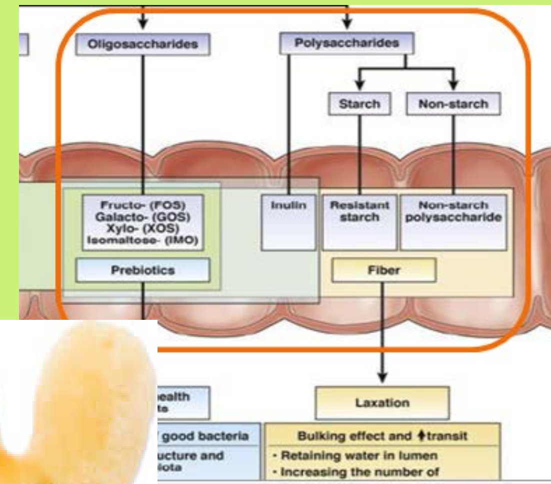
Figure 1 | **Distinguishing what is considered a prebiotic with the proposed definition.** Prebiotics must be selectively utilized and have adequate evidence of health benefit for the target host. Dietary prebiotics must not be degraded by the target host enzymes. *The figure shows candidate as well as accepted prebiotics in that levels of evidence currently vary, with FOS and GOS being the most researched prebiotics.CLA, conjugated linoleic acid; PUFA, polyunsaturated fatty acid; FOS, fructooligosaccharides; GOS, galactooligosaccharides; MOS, mannanoligosaccharide; XOS, xylooligosaccharide.

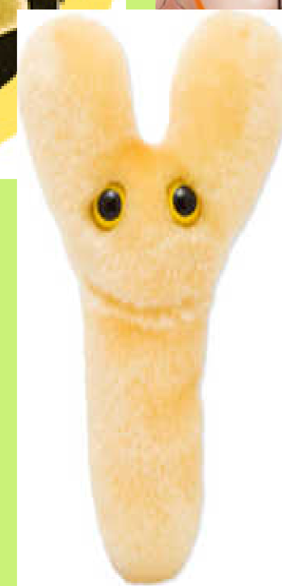
Gibson et.al., 2017, The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on the definition and scope of prebiotics

Präbiotika – wer frisst wen?

Bifidobacterium:

- Fruktane
- Galaktane
- Oligosaccharide der Muttermilch (human milk oligosaccharides, HMO)

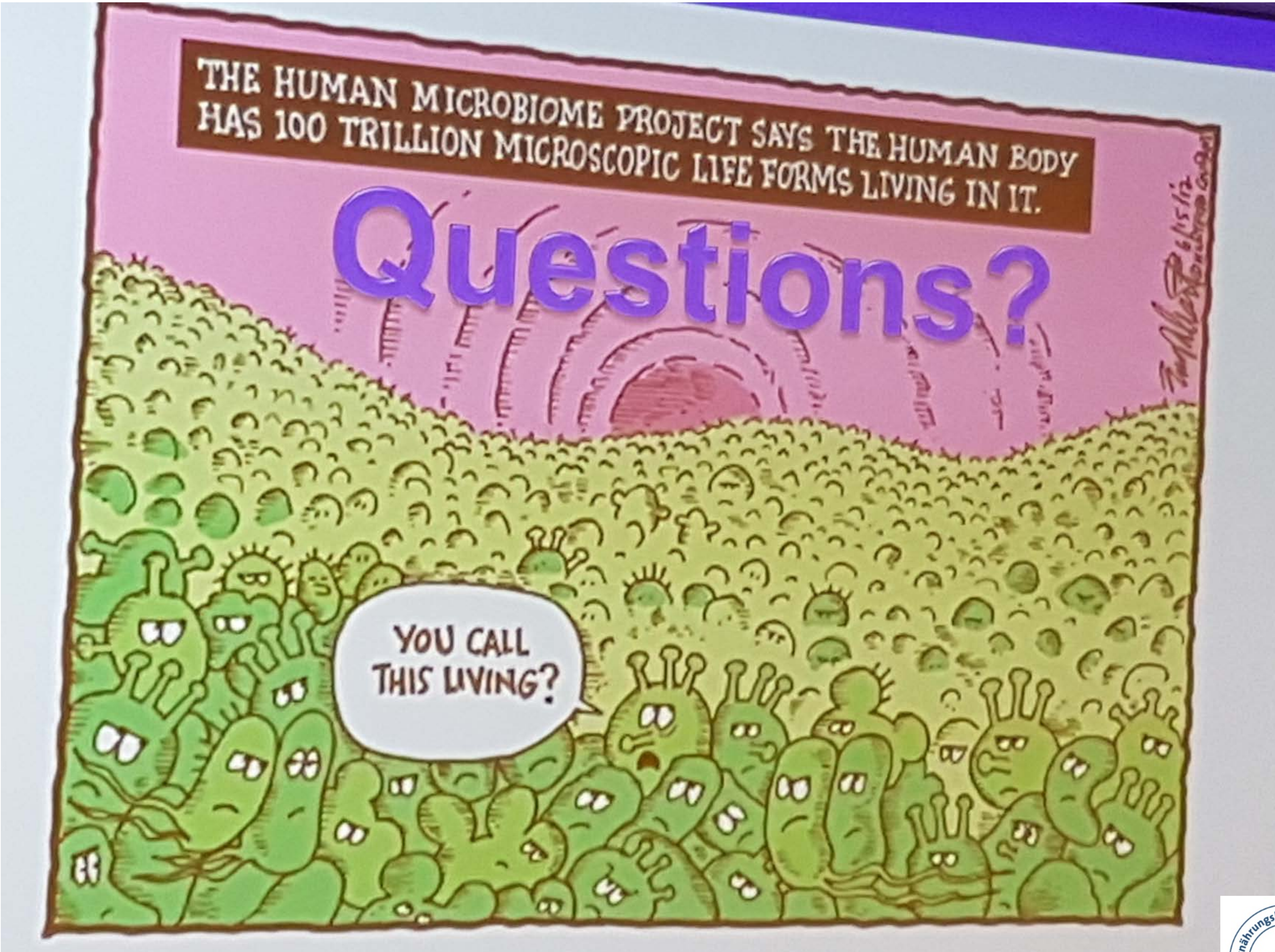




Derer, 2017, Modulation der intestinalen Mikrobiota durch Ernährungsinterventionen
Maukonen & Saarela, 2014, Conference on diet, gut microbiology and human health, Symp.3: Human gut microbiota: does diet matter?
Gibson et.al., 2017, The International Scientific Association for Probiotics and Prebiotics (ISAPP) consensus statement on the definition and scope of prebiotics
Scientific Advisory Committee on Nutrition. 2015. Carbohydrates and Health.

TAKE HOME

- biochemische Einteilung sagt nichts über physiologische Eigenschaften aus
- «löslich vs. unlöslich» ist obsolet
- Ziel: Einteilung nach Verdaubarkeit
- Feuchtigkeitsgehalt + konstante Konsistenz = geregelter Stuhlgang
- Nicht alle Präbiotika sind Nahrungsfasern.
  Nicht alle Nahrungsfasern sind präbiotisch.
- Nahrungsfasersupplemente sind nur so gut, wie die Instruktion zur Einnahme


THE HUMAN MICROBIOME PROJECT SAYS THE HUMAN BODY HAS 100 TRILLION MICROSCOPIC LIFE FORMS LIVING IN IT.
Questions?
YOU CALL THIS LIVING?