

Gut Feelings: Considering and Capturing Tolerance to Nondigestible Carbohydrates

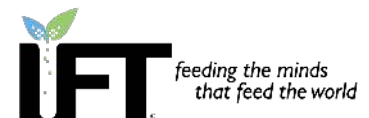
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Holscher disclosures

Relationship (prior 48 months)	Interest
Employee	University of Illinois Urbana-Champaign
Grant/Research Support	Almond Board of California, Bio-Cat, California Walnut Commission, Foundation for Food and Agriculture Research, General Mills, Hass Avocado Board, National Honey Board, Tate & Lyle, USDA
Speaking Honoraria	Beneo, Council for Responsible Nutrition, Dietitian Connection, Global Prebiotic Association, Idaho Barley Commission, ISAPP, National Dairy Council
Consulting/Advisory Board	Bobbie Baby, DSM, Haleon



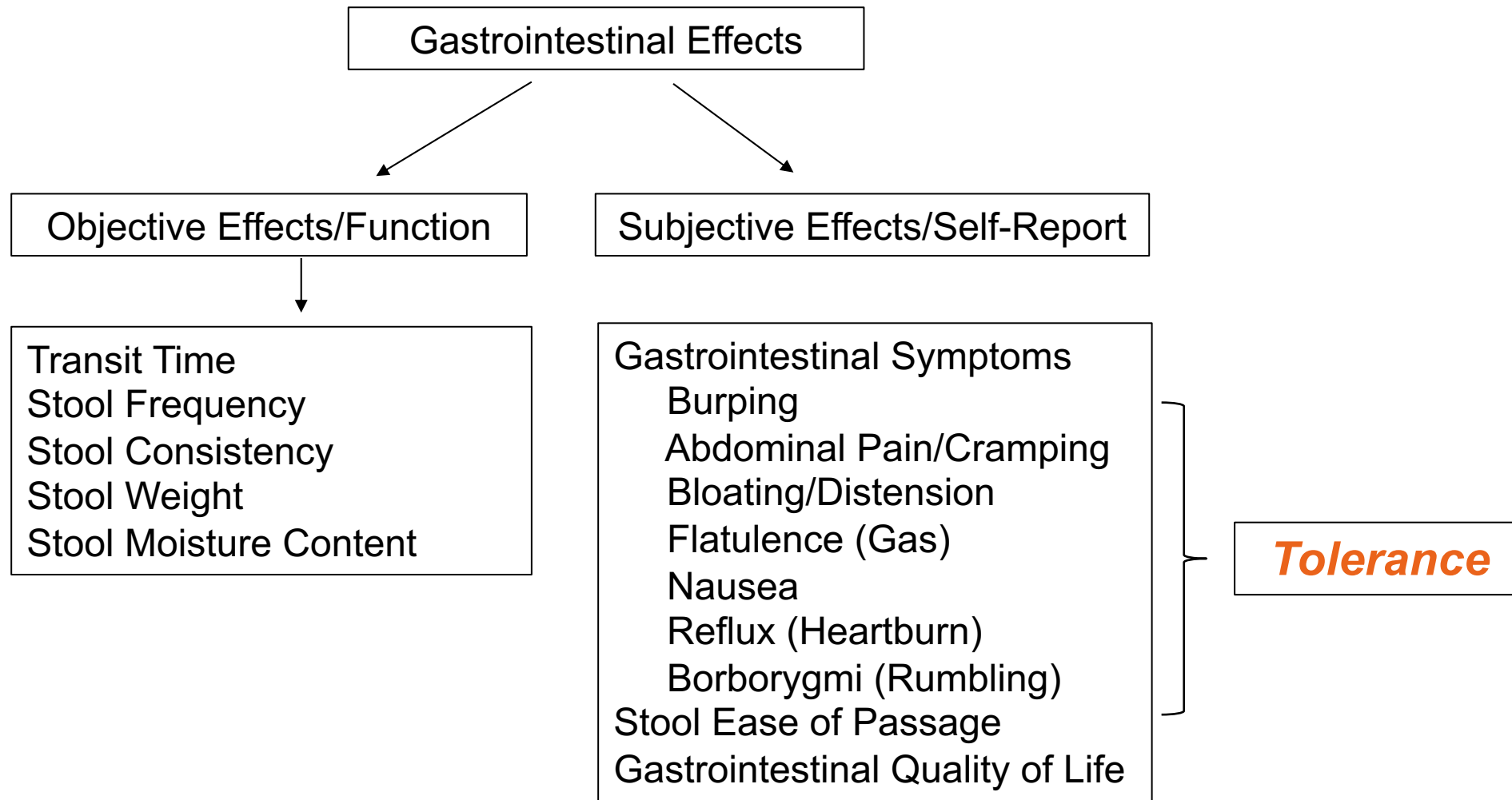
Outline

- 1 Tolerance to nondigestible carbohydrates
- 2 Considerations for assessing tolerances
- 3 Tools and resources for assessing tolerance



Tolerance

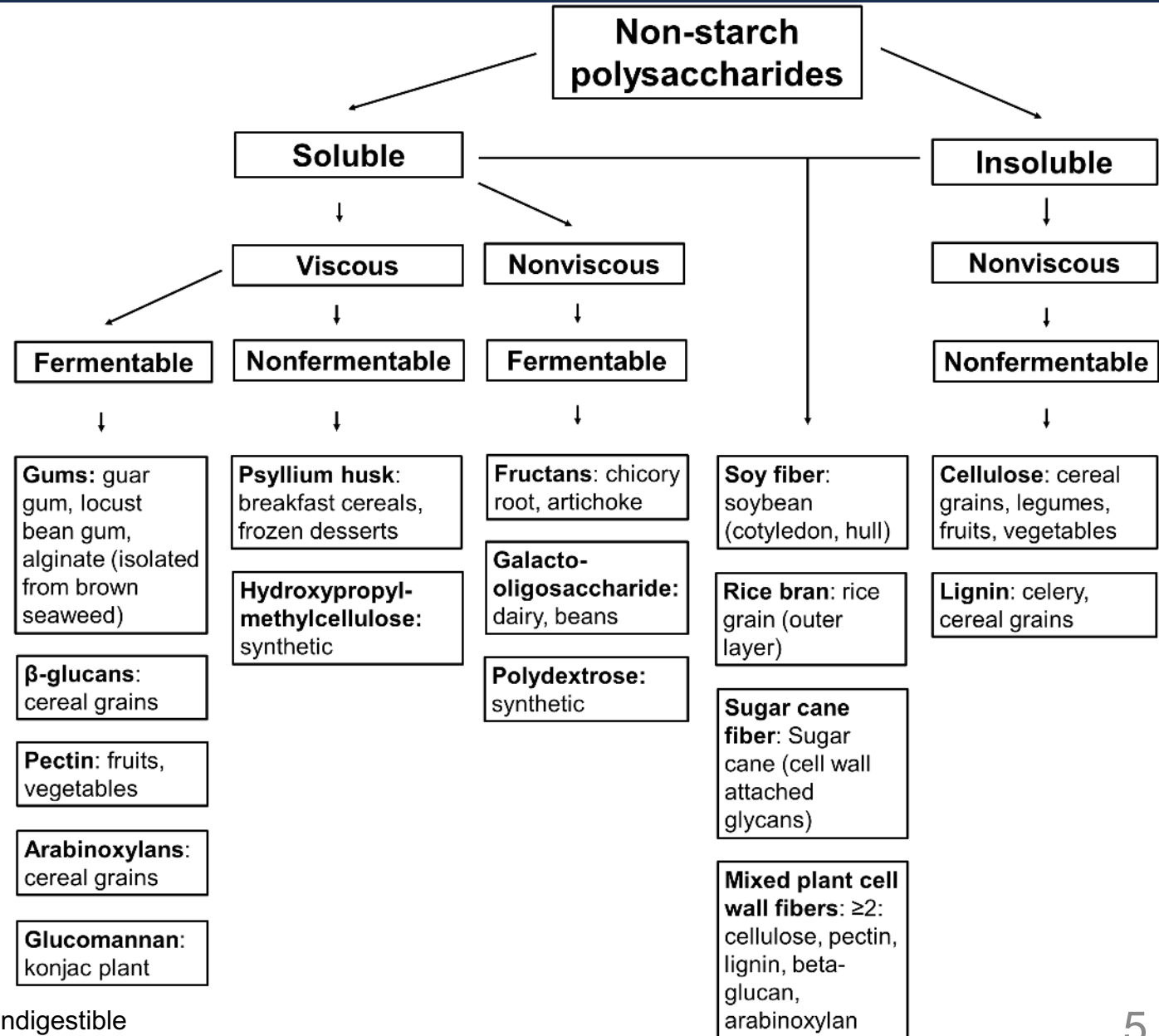
Tolerance is the self-reporting of various gastrointestinal symptoms.





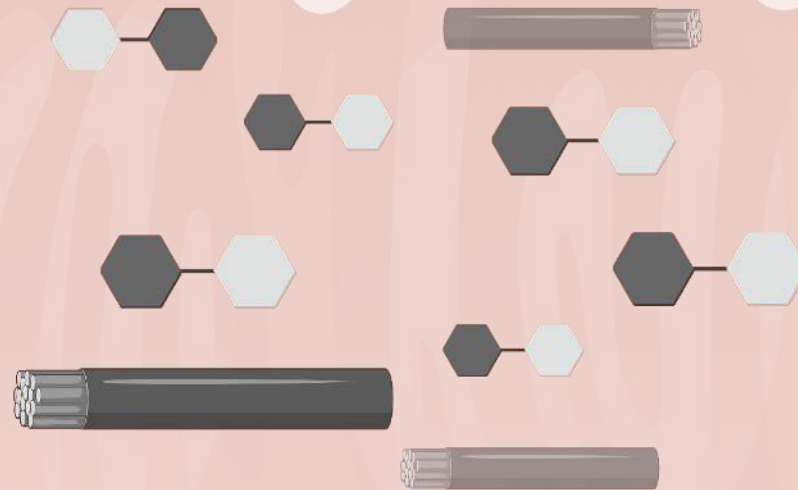
Fibers are heterogeneous

- Nonstarch polysaccharide classifications:
 - solubility
 - viscosity
 - fermentability



Solubility and Viscosity Affect Tolerance

**Nondigestible
Carbohydrates**

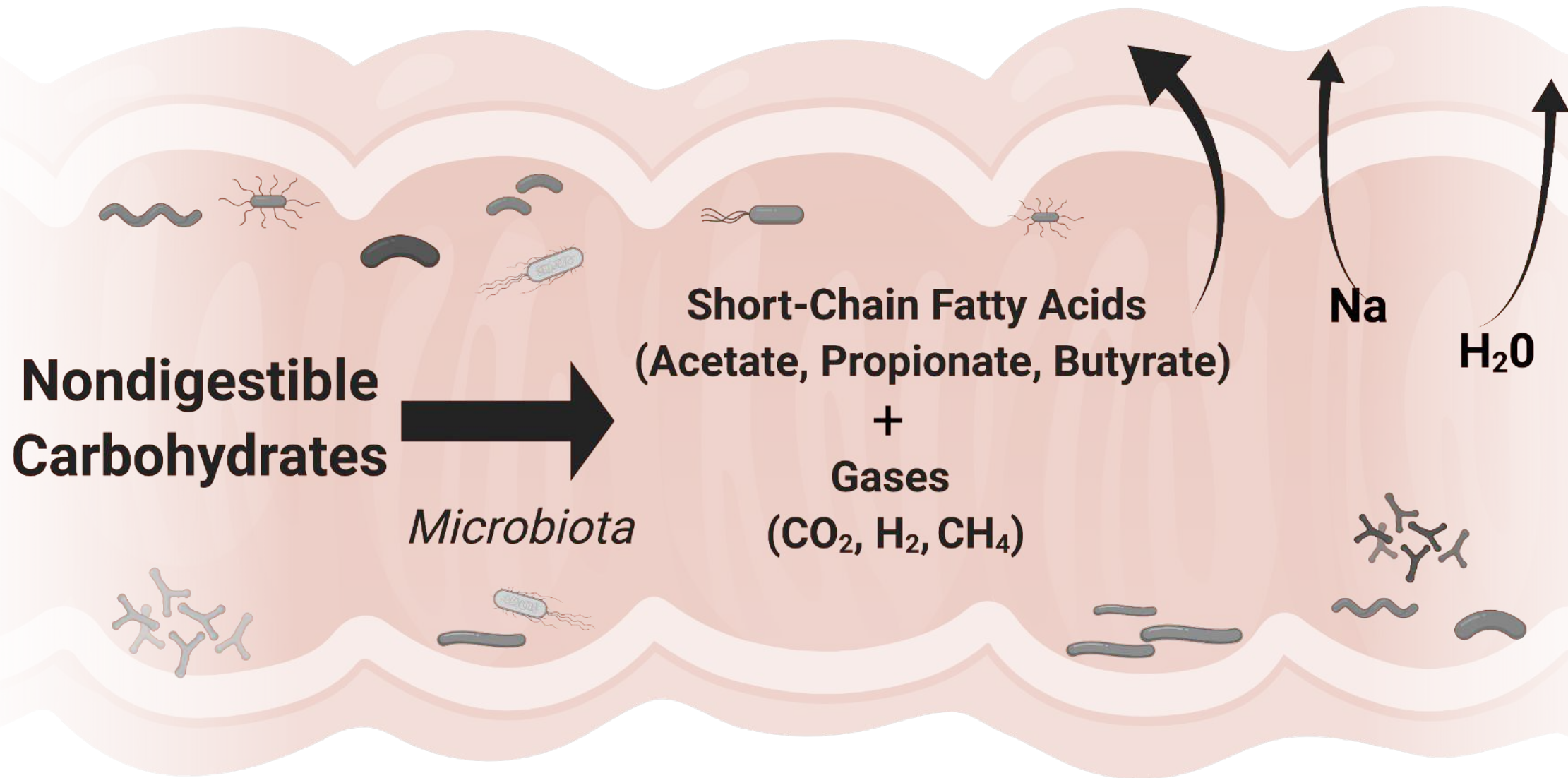


H₂O

H₂O

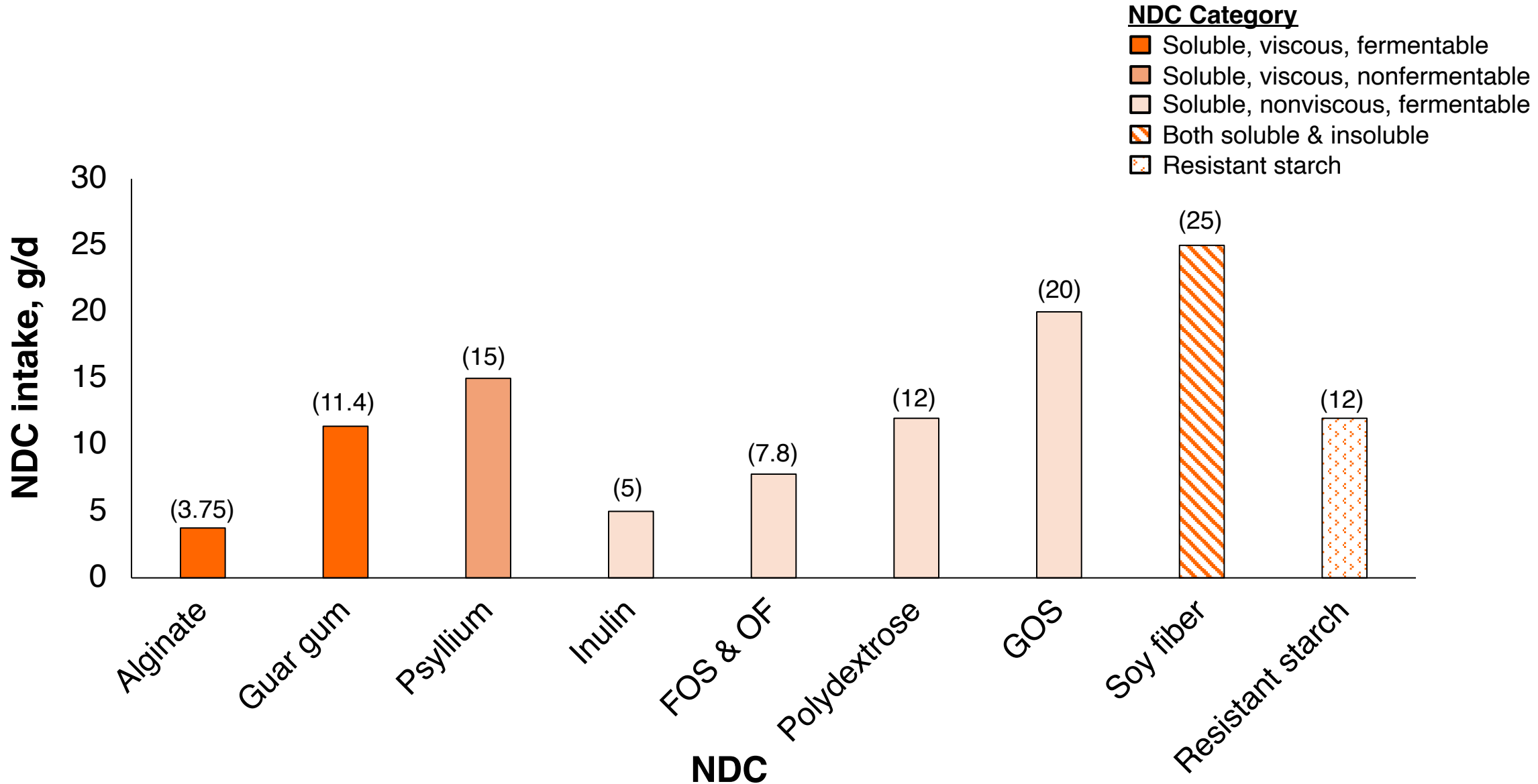


Fermentability Affects Tolerance





Range of tolerable intakes of NDCs





Balancing benefits with tolerance

NDC health benefits, therapeutic doses, and tolerable intake recommendations

NDC	Health Benefit	Therapeutic Dose (g/d)	Tolerable Intake (g/d)
Alginate	↓ Post-prandial blood glucose	1.5-8	3.75
Guar gum	↓ Blood cholesterol	≥ 15	11.4
Psyllium husk	↓ Coronary heart disease	≥ 7	15
Inulin	Improved laxation	15-50	5
FOS and OF	↑ Mineral absorption	10-15	7.8
Polydextrose	↓ Energy intake	12-25	12
GOS	↑ Intestinal calcium absorption	20	20
Soy fiber	↓ Blood cholesterol	10-26	25
	Improved laxation	8.2-26	
Resistant starch	↑ Calcium absorption, retention, and bone formation	10-20	12



Tolerance Assessment Considerations

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Perspective: Assessing Tolerance to Nondigestible Carbohydrate Consumption

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Tolerance Assessment Recommendations

Measures

- Capture baseline symptoms before acute challenge or during a lead-in period.
- Acute tolerance studies (one-time challenges): monitor symptoms for at least 0-48 hours
- Acclimation studies: Assess tolerance outcomes over >14 days
- Adequate washout period

Intervention

- Fully report the NDC characterization and how the NDC is consumed
- Negative comparators should match the food product but contain no NDC ingredient.
- Positive controls

Population

- Consider age, health, diet, lifestyle, and medication when establishing inclusion/exclusion criteria.

Outcome

- Assess **subjective participant-reported symptoms** via standard gastrointestinal questionnaires as the primary tolerance measures.
- Objective outcome parameters can complement gastrointestinal questionnaires, **not** replace them.



Tolerance Assessment: Tools

Over the past **24 hours**, indicate the severity of the following factors:

	0 (Absent)	1 (Mild)	2 (Moderate)	3 (Severe)
Burping				
Cramping/pain				
Distension/bloating				
Flatulence/gas				
Nausea				
Reflux (heartburn)				
Rumblings				



Tolerance Assessment: Tools

Did you have any bowel movements **today**? Yes No
(If Yes, please complete the following):

Time (AM/PM)

Consistency*						
1	2	3	4	5	6	7

Ease of Passage**				
1	2	3	4	5

Bristol Stool Chart

Type 1		Separate hard lumps, like nuts (hard to pass)
Type 2		Sausage-shaped but lumpy
Type 3		Like a sausage but with cracks on its surface
Type 4		Like a sausage or snake, smooth and soft
Type 5		Soft blobs with clear-cut edges (passed easily)
Type 6		Fluffy pieces with ragged edges, a mushy stool
Type 7		Watery, no solid pieces. Entirely Liquid

Saad RJ, Rao SS, Koch KL, Kuo B, Parkman HP, McCallum RW, et al. Do stool form and frequency correlate with whole-gut and colonic transit? Results from a multicenter study in constipated individuals and healthy controls. *Am J Gastroenterol* 2010;105:403-1, and adapted from Lewis SJ, Heaton KW.



Tolerance Assessment: Tools

Gastrointestinal Tolerability Questionnaire

Question	Answer					
1) Did you experience any nausea in the past <u>7 days</u> ?	<table border="1"><tr><td><input type="checkbox"/> Yes</td><td><input type="checkbox"/> No</td></tr></table> <p>If yes, how would you rate the amount of nausea?</p>	<input type="checkbox"/> Yes	<input type="checkbox"/> No			
	<input type="checkbox"/> Yes	<input type="checkbox"/> No				
	<table><tr><td>No more than usual</td><td>Somewhat more than usual</td><td>Much more than usual</td></tr><tr><td><input type="checkbox"/></td><td><input type="checkbox"/></td><td><input type="checkbox"/></td></tr></table>	No more than usual	Somewhat more than usual	Much more than usual	<input type="checkbox"/>	<input type="checkbox"/>
No more than usual	Somewhat more than usual	Much more than usual				
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>				



Tolerance Assessment: Tools

Gastrointestinal Symptom Rating Scale (GSRS)

- A **validated tool** that queries symptoms over the past week
 - ▣ Developed as a disease-specific instrument^{1,2}
 - ▣ Norm values for the general population are available³

- The GSRS has been used in healthy adults consuming NDC.⁴⁻⁶

1. Svedlund J. Dig Dis Sci. 1988; 33(2): 129-34

2. Dimenäs E. Scand J Gastroenterol. 1993; 28(8): 681-7

3. Dimenäs E. Scand J Gastroenterol. 1996; 31:8-31

4. Dennis-Wall JC. J Funct Foods. 2019; 60: 103438

5. Alyousif Z. Curr Dev Nutr. 2020; 4: 1-116.

6. Hughes C. Am J Clin Nutr. 2011; 93: 1305-11



Key Takeaways

1

NDC differentially
affect tolerance.

2

Important to
assess tolerance.

3

There are
tools available.