Sourdough bread and health

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Do fermentation organisms matter?

Sourdough lactobacilli significantly overlap with intestinal organisms:…
https://doi.org/10.1016/j.ijfoodmicro.2018.08.019

… but then there are baking ovens…

http://dx.doi.org/10.1016/j.cmet.2017.05.002,
https://doi.org/10.3389/fnut.2020.615003

Carbohydrates (%) in wheat and rye grains

Saccharide	Wheat	Rye
Starch	66 - 70	60 – 65
Arabinoxylans	6–7	7–12
β-Glucans including lignified cellulose	0.3–3	2–3
Pectin	trace	trace
Mannans, galactans, and galacturonans	1–1.5	n.d.
Fructans	1–2	4.3–5
1-Kestose	0.1	0.3
Nystose	0.03	0.1
Sucrose	0.6–1.0	1.2–1.8
Raffinose	0.2–0.7	0.1–0.7

http://dx.doi.org/10.3390/foods7070096

Is starch a digestible polysaccharide?

It depends on the context: Glycemic index of different breads

Bread type	GI relative to glucose	GI relative to white bread	Fibre?	Sourdough?	Whole grain?
Gluten-free	79	113			
Wonder, enriched white bread	71	101			
Whole-meal flour	71	101	■		
Whole-meal barley flour bread	70	100	■		
Gluten-free fiber-enriched	69	99	■		
Whole-meal rye bread	67	95	■		
Whole-meal barley flour bread with lactic	66	94	■	■	
Whole-meal barley sourdough	53	76	■	■	
Whole grain wheat	53	76	■		■
Sourdough rye	48	69	■	■	
White bread + 15 g psyllium fiber	41	59	■		
Rye-kernel bread, pumpernickel	41	58	■	■	■

https://doi.org/10.1093/ajcn/76.1.5

interim summary – sourdough, fibre and starch digestion

whole flour

+

sourdough

+

whole grains

= low GI bread

(e.g. Pumpernickel)

Dietary Fibre, Gut Microbiota, and Host Health

Diverse non-digestible carbohydrates in whole grains stimulate diverse microbes:

- increased resilience, diversity and metabolic activity

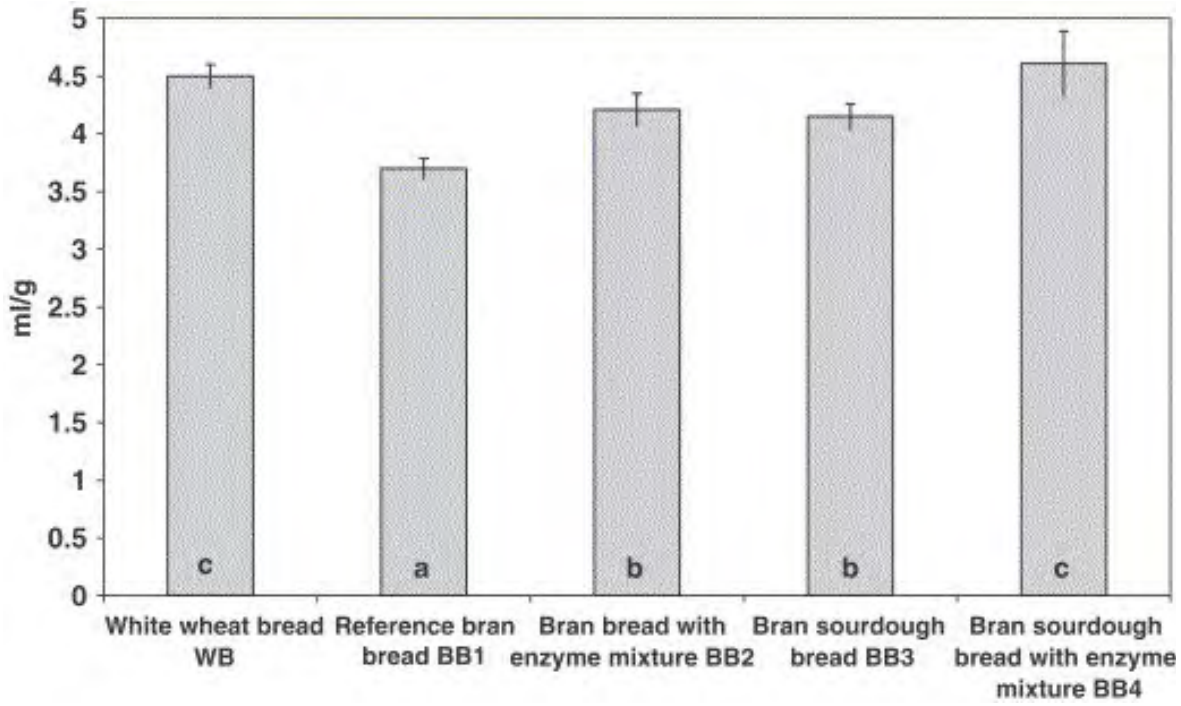
Key health benefits are mediated through production of short-chain fatty acids:

- prolonged satiety
- improved glucose tolerance
- reduced inflammation
- reduced pH and reduced protein fermentation in distal colon

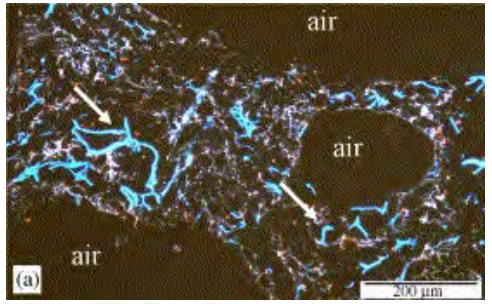
https://doi.org/10.1128/9781555819705.ch20

Technological effect of sourdough in whole grain / high fibre baking: Healthy & Tasty!

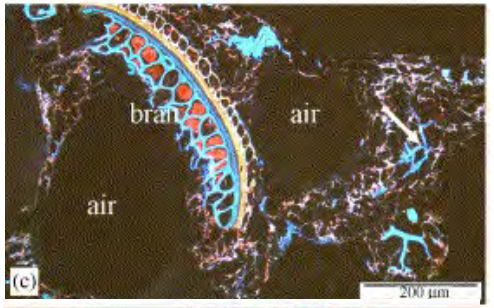
Bread volume



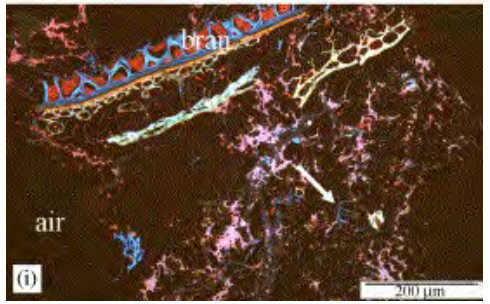
Crumb structure stained to visualize protein and cell walls



White bread



Bran bread



Bran bread + sourdough

https://doi.org/10.1016/j.lwt.2005.03.013

interim summary –
sourdough, fibre and intestinal microbiota

Water insoluble fibres

[cereal enzymes]
[low pH]

Water soluble fibres

- Sourdough fermentation converts high fibre ingredients with negative impact on product quality into high fibre ingredients with positive impact on product quality

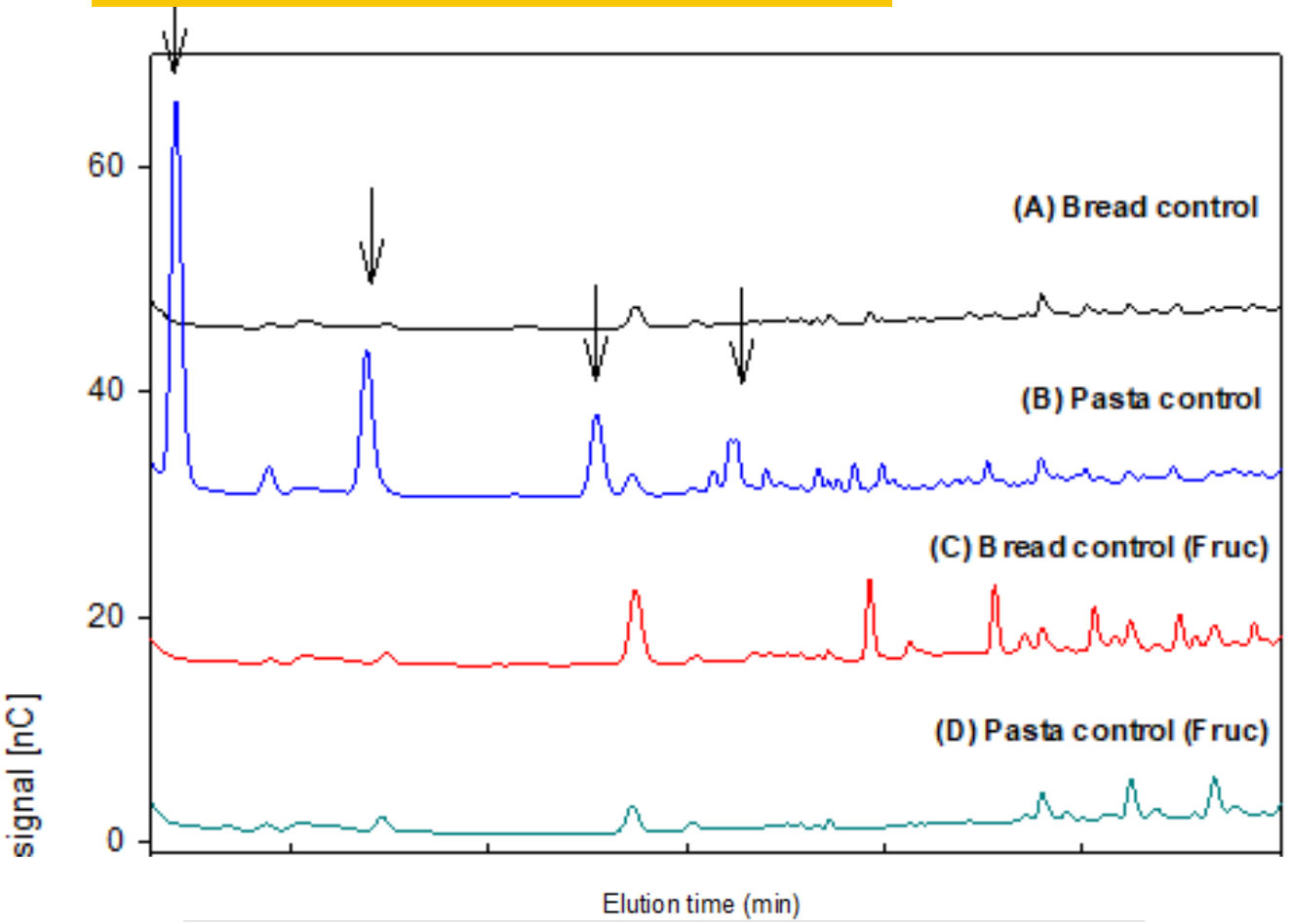
https://doi.org/10.1016/j.lwt.2005.03.013

FODMAPs, irritable bowel syndrome and sourdough

- **F**ermentable **O**ligosaccharides, **D**isaccharides, **M**onosaccharides And **P**olyols
- Rapid fermentation causes gas, bloating, and osmotic diarrhea
- Contribute to adverse symptoms in patients with irritable bowel syndrome.
- “low FODMAP diet” is an increasing trend in functional food development.
- A low FODMAP diet is typically also a **no wheat** and **low fibre** diet and depletes bifidobacteria in the intestinal microbiota.

http://dx.doi.org/10.1136/gutjnl-2015-309757,
https://doi.org/10.1053/j.gastro.2019.09.024

Degradation of FODMAPs in bread and pasta made with the same durum semonila



Long proofing times + invertase produced by baker's are sufficient to degrade wheat fructans

- Long fermentation times result in bread that are better tolerated.

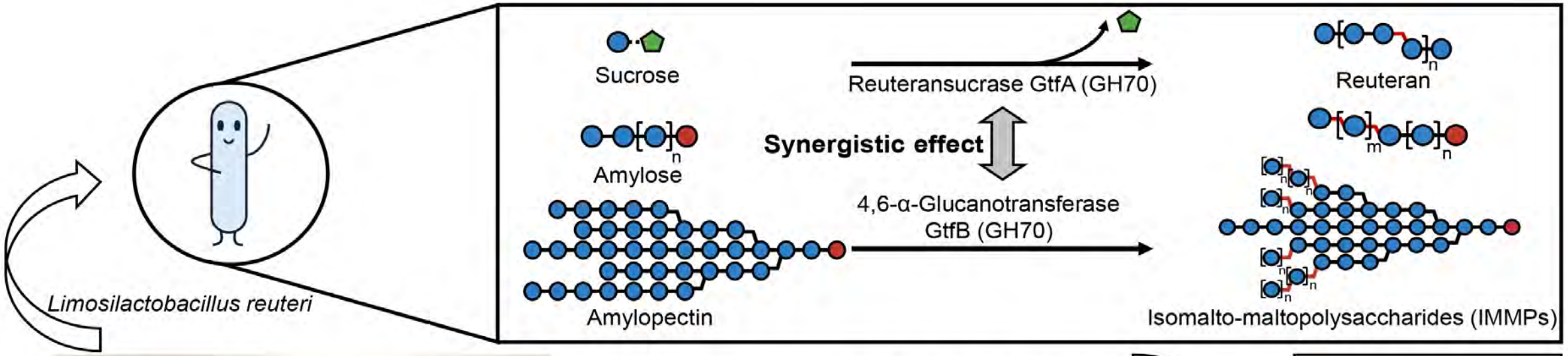
interim summary – sourdough, FODMAPs and IBS

- yeast invertase degrades fructans in wheat and rye baking if the proofing time is sufficiently long (which is always is in sourdough baking)

- impact on other offending components (amylase tyrpsin inhibitors, wheat germ agglutinin) likely but not confirmed

➢Sourdough fermentation allows production of high fibre products that may be suitable for individuals with non-celiac wheat sensitivity

Glucansucrases and glucanotransferases of Lm. reuteri, and starch digestibility



Sourdough bread
Lm. reuteri TMW1.656Δ*gtfA*

Straight dough bread

Improved bread quality

- Bread volume
- Total dietary fiber
- Starch digestibility

- Non-reducing glucose unit
- Reducing glucose unit
- Fructose
- α-1,4 bond
- α-1,2 bond
- α-1,6 bond

Summary:

Sourdough bread, intestinal microbiota and host health

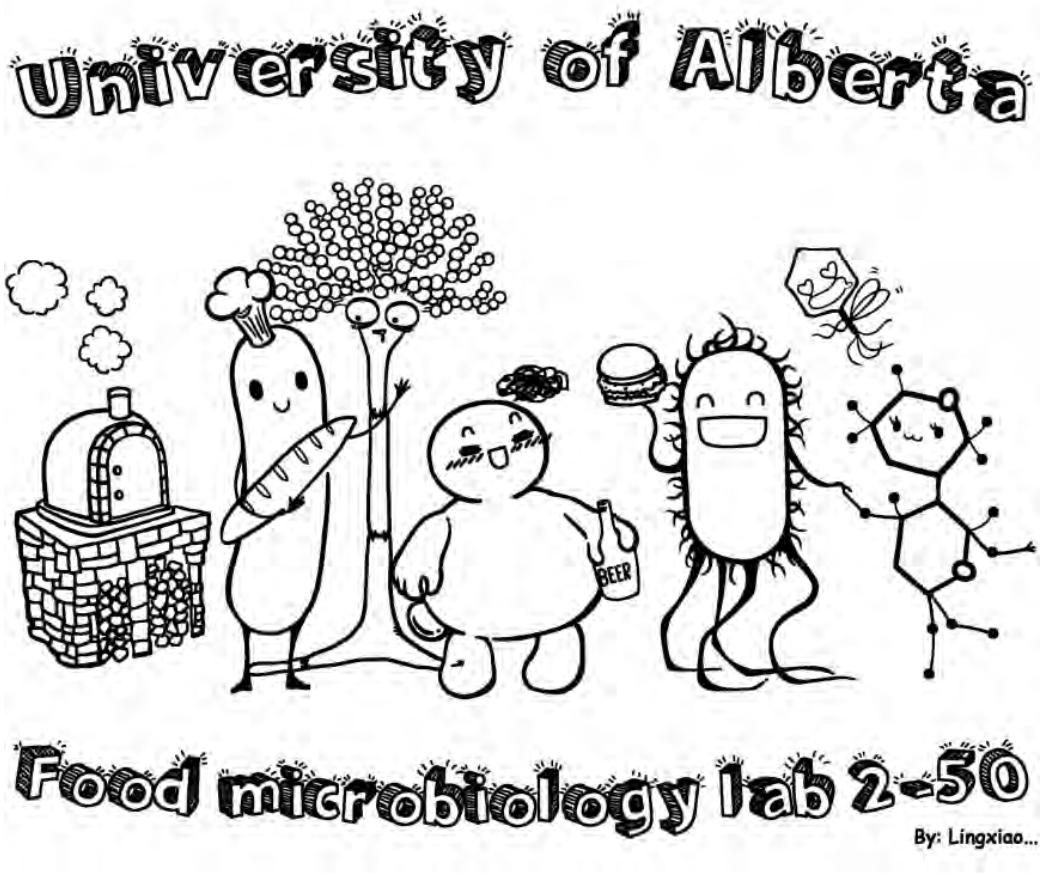
- Sourdough, when used in conjunction with high fibre and / or whole grains, reduces starch digestibility
- Sourdough improves the technological functionality of high fibre ingredients
- Sourdough fermentation allows production of high fibre products that may be suitable for individuals with non-celiac wheat sensitivity
- Additional health effects of sourdough that are related to strain-specific metabolic traits remain to be confirmed in clinical trials.

Sourdough is an indispensable tool for high quality, high fibre products with beneficial impact on the gut microbiome and host health

Sourdough bread = healthy and tasty!

Acknowledgements

The team...



…You for your attention