

Dietary fibre and gut health: Not all fibres are alike

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Dietary fiber intake is low

- Typical fiber intake in US is 15 grams per day – recommended levels are 25 – 38 g/day
- Most fiber-containing foods – 1 – 3 g of fiber
 - Apple – 3 grams
 - Lettuce – 1 gram
 - WW bread – 2 grams
 - Oatmeal – 3 grams
- White flour and white potatoes provide the most fiber in the US diet, not because they are concentrated fiber sources, but because they are widely consumed
- Interest in the addition of functional fibers to the food supply to increase fiber intake
- Slavin. Health implications of dietary fiber. *J Am Diet Assoc* 2008;108:1716-1731.



Normal digestion and absorption

- Typically about 95% of macronutrients (carbohydrates, fats, proteins) get digested and absorbed
- Leftovers of digestion and absorption (feces) include fiber, bacteria, water
- Making nutrients less digestible (low digestible carbohydrates – starch, sugar alcohol, etc) – may lower calories but may create issues – intestinal gas, diarrhea, etc



Fermentable Carbohydrates

- Lactose and sucrose, on occasion
- Dietary fiber
- Functional fiber
- Oligosaccharides
- Resistant starch
- Sugar alcohols/rare sugars



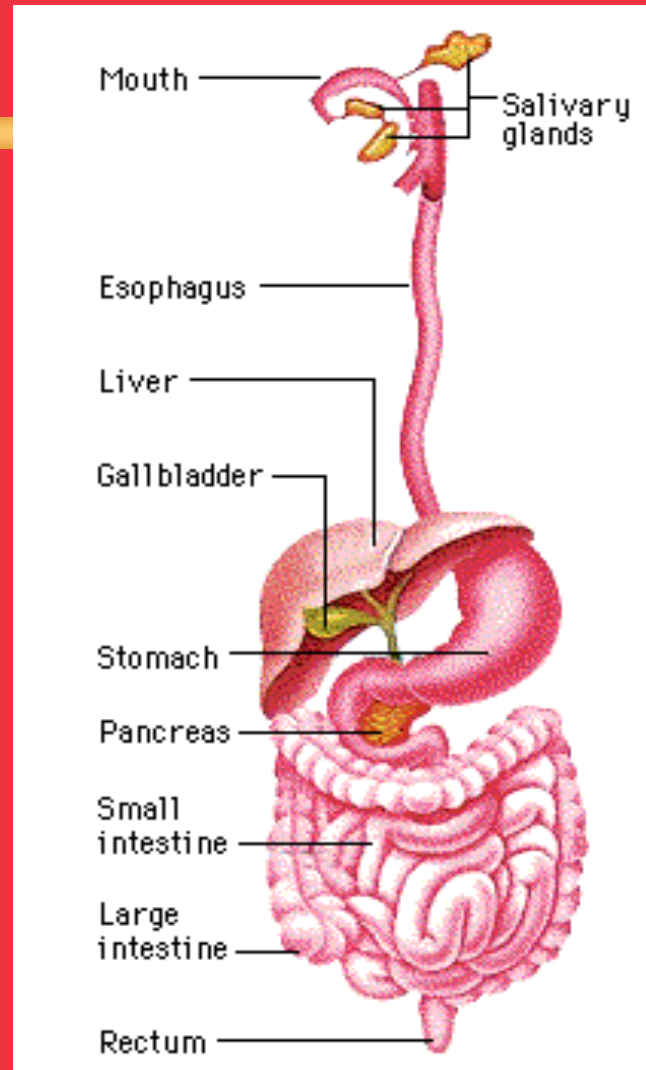
Non-fermentable/Poorly Fermentable Carbohydrates (and Lignin)

- Some celluloses and hemicelluloses
- Resistant maltodextrins
- Lignin (polyphenolic compound)



Fermentable carbohydrate: GI Tract

- Incompletely digested and partially absorbed in small intestine
 - Bonds resistant to digestive enzymes
- Fermented by bacteria in large intestine
 - SCFAs, H₂, CH₄, CO₂
- And/or excreted in feces



Fate of fiber in the gut

- Fiber digestibility ranges from 2 – 100%
- Little Solka Floc (purified cellulose) is degraded during transit
- Difficult to measure fiber disappearance since microbial cell wall in feces inflate values
- Slavin et al. *J Nutr* 1981;111:287-297.



Fiber balance studies

- Must feed defined, controlled diet for a long enough time for adaptation
 - Wheat bran (56%)
 - Oat bran (96%)
 - Polydextrose (50%)
 - Pectin (100%)
 - Psyllium (25 – 50%)



Fiber fermentation measures

- Intubation studies – considered gold standard – very invasive
- Ileostomy model – different GI tract
- Hydrogen breath test – does not relate to symptoms – best for acute studies
- SCFAs in venous blood or in feces
- Fiber in fecal samples
- Fecal microflora



Limitations to fecal samples

- Not practical in epidemiological studies
- No accepted standard
 - Stool weight
 - Stool chemistry
 - Microflora – methods, what is best
 - Stool frequency (easy to collect)
 - Quality of life (used in IBS trials)



What is gut health?

- Normal bowel function – subjective
- Regular bowel movements
- Desirable bowel movements – not diarrhea or constipation
- Absence of symptoms – bloating, gas, noises, pain
- Quality of life suffers greatly when gut health is compromised



Common gut health issues

- Constipation – how easily and how regularly you have a bowel movement
 - Low fiber diet
 - Sedentary lifestyle
 - Resisting the urge to have a bowel movement
 - Stress
 - Long-term laxative use
 - Some medications



Exit strategy – how to stay regular

- 15% adults report chronic constipation
- More common in older people
- At least twice as common in women
- Spend \$750 million on laxatives and irregularity leads to 8 million trips to the doctor and \$7 billion for evaluation and diagnostic testing
- Nutrition Action Newsletter, March 2009



CELEBRITY KAKA

a who's who of poo.



Martha.



Paris and
Tinkerbell.



Keanu.



Brangelina.



Arnold.



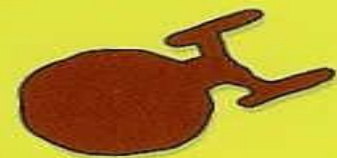
Tiger.



the
Papal Pile.



the
Donald Dump.



Captain's Log.



Bush Bombs.



Condoleezza's
rice.



Defining gut health




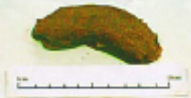


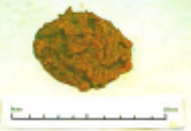


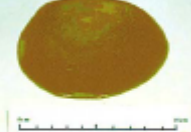


- Less than 3 stools per week or more than 3 stools per day – considered abnormal
- Stool weight greater than 200 g/day is clinically defined as diarrhea, but many vegetarians have stool weights of 300 g/day or more
- Stool consistency important to consumers – requires presence of water-insoluble fecal solids such as non-digested dietary fiber or bacterial cell walls
- Gastroenterology 1999;116:1464



Non-dietary factors that affect laxation

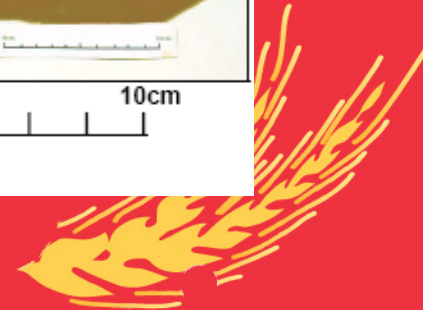
- Stress
- Exercise (Oettle. *Gut* 1991;32:941)
- Smoking
- Coffee drinking
- Drugs (laxatives) (Lembo A, Camilleri M. *New Eng J Med* 2003;349:1360)
- Personality (Tucker et al. *Gastroenterology* 1981;81:879)



	Less than 100g	Between 100 – 200g	More than 200g
Hard & Formed - hard or firm texture - retains a definite shape - like a banana a cigar or marbles	A 	B 	C 
Soft & Formed - retains general shape - like peanut butter	D 	E 	F 
Loose & Unformed - lacks any shape of its own - may spread easily - like porridge or thick milkshake	G 	H 	I 
Liquid - runny - like water	J 	K 	L 

King's Stool Chart © 2001 King's College London
www.kcl.ac.uk/stoolchart

Scale 0cm 10cm



dribbleglass.com

ELLER

Come check out
our stool
samples.



Gut health and fiber

- Confounding Issues:
 - Many other diet factors affect laxation
 - Confounding effects of laxative use
 - Difficult to collect stool samples in these settings
 - Wet and dry stool weight, transit time, fecal chemistry, microflora, how long to collect
 - Are subjective measures enough support?
 - Frequency, ease of elimination, bloating, flatulence



Nutrition and lifestyle and bowel movement frequency

- 20,630 subjects in EPIC
- Higher in men than women
- Higher in vegetarians – linked to fiber intake
- Positively associated with BMI
- Positively associated with vigorous exercise in women, not as clear in men
- Sanjoaquin et al. *Pub Health Nutr* 2004;7:77-83.



Fecal bulking index (FBI)

- Increase over baseline in rehydrated fecal weight induced by a food, as a percentage of the increase induced by an equal weight of wheat bran reference
- Fecal weight required for health – 200 g/day (Spiller 1993)
- Fecal weight/g wheat bran fiber - 5.11 g (Cummings 1993)
- Monro. *Eur J Clin Nutr* 2004;58:32-39



Average increase in fecal weight per gram fiber fed

- Wheat 5.4 g/g fiber fed
- Oats 3.4 g/g fiber fed
- Corn 3.3 g/g fiber fed
- Legumes 2.2 g/g fiber fed
- Pectin 1.2 g/g fiber fed
- Cummings JH. 1993. CRC Handbook of Dietary Fiber in Human Nutrition



Summary of tolerance data

- Dietary fiber – up to 80 g/d in vegetarians – no UL
- Polydextrose – 50 g
- Resistant starch – 80 g
- Fructo-oligosaccharides – 10-15 g – diarrhea at 40 g
- Sugar alcohols
 - No effect dose – 20-50 g
 - Laxation threshold – 50-70 g
 - Grabitske & Slavin. *Cr Rev Food Sci Nutr* 2009; 49:327-360.



Dietary fiber and laxation

- Not all fibers are equally effective in increasing stool weight
- Wheat bran is most effective and fibers that are extensively fermented during gut transit time (inulin, pectin, etc) have little effect on stool weight

