Nutrition and the Microbiome

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PHYSICAL

Nutrition

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Dietary Influence on Diversity of the Microbiome

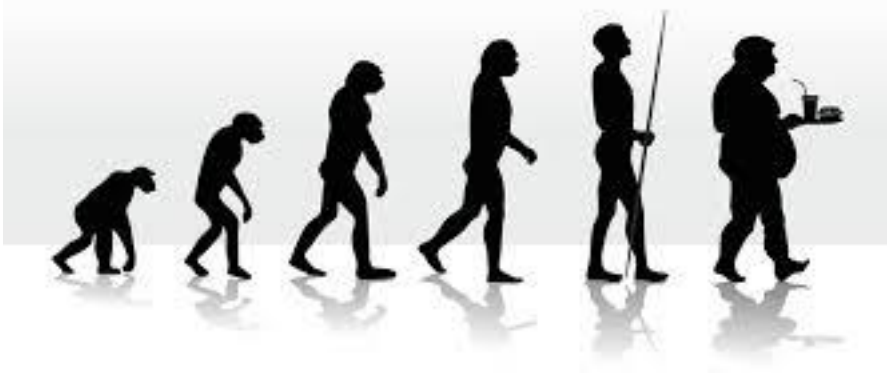
- How different food choices can affect the composition of the microbiome.
  - Fibre
  - High carb vs high protein vs high fat
  - Animal protein vs vegetable protein
  - FODMAPs

Global Diversity of the Microbiome

- US and European microbes distinct from each other.
- Smaller regions such as Spain and Denmark can be distinguished by their microbes
- Japanese people have genes from marine Bacteroides species that degrade seaweed in the gut
  - These are not seen in land dwelling communities
  - Are people without these factors in their gut able to digest these foods?

Evolution of the Microbiome

- Analysis of hunter gatherer diets
  - Very rich in fibre
  - Very diverse microbiome
- Introduction of agriculture
  - Decline in diversity of microbiome



- Western world
  - Preservatives, emulsifiers, low fibre, antibiotics
    - We are extinguishing the microbes that our ancestors had
- Conditions such as multiple sclerosis and inflammatory bowel disease did not exist in ancestral communities.

Diversity

- Diversity of the microbiome is key for good health
- Low diversity linked to a multitude of chronic disease
- Diversity is driven by diversity of the diet
  - Bland diet of highly processed foods leads to low diversity
- You are what your microbes eat!

Diversity

- Affected by:
  - Weekly plant food count
  - Prebiotic use
  - C-Section vs vaginal birth
  - Breastfed vs bottle-fed
  - Antibiotics
    - Recent use
    - Childhood use
    - Frequency of use
    - Cocktail
  - NSAID use
  - PPI use
  - Urban vs country living
  - Restrictive diet

Diet and Diversity

- Our gut bacteria LOVE fibre

- Our beneficial gut bacteria do NOT LOVE low fibre, processed foods
  - Less diversity
  - Hungry bacteria
    - May start to eat mucal barrier
  - Starves the good bacteria
  - Encourages growth of bad bacteria

Microbial Diversity

- Improved by:
  - A wide, varied plant based diet
    - Eat the rainbow
    - 40+ different whole, unprocessed plant foods weekly
  - High fibre foods
    - Resistant starches
    - Polyphenols
    - Prebiotic-rich foods
    - Mucilages
    - Pectins
    - Soluble and insoluble fibres

Resistant Starch 1

- Grains, seeds, legumes
- Not broken down by our normal digestive processes
- Broken down by some gut bacteria and inner starch consumed by microbiome
- Cooked oats vs. Soaked oats
  - Cooking process breaks down starch
    - Also higher GI
  - If soaked oats, more resistant starch reach the microbiome
    - Lower GI

Resistant Starch 2

- High in plantain flour, green banana flour and potato flour
- Must be eaten unheated (eg. Smoothie) or resistant starch is lost
- Cooking makes starch digestible so it doesn’t reach microbiome intact.

Resistant Starch 3

- Formed when starchy foods such as root vegetables and whole grains are cooked then cooled
- Aka retrograde starch
- Cooling process converts digestible starches to resistant starches.
- High in legumes
  - Black beans – loaded with black polyphenols

Soaking and Sprouting

- Makes foods high in resistant starch easier to digest => less gas
- BUT
  - Less resistant starch and not as nourishing for the microbiota

Diet and the Microbiome

- High polyphenol, raw plant foods, tea, coffee, dark chocolate, red wine
  - Linked to high diversity
  - Blue zone diets very high in a diverse range of plant based foods

Polyphenol Rich Foods

- Vegetables
  - Broccoli, purple and orange carrots, red lettuce, red cabbage, purple/red potatoes.
- Fruits
  - Black elderberries, black currants, cherries, strawberries, blackberries, plums, raspberries, apples (red), black grapes
- Nuts and Seeds
  - Flaxseed meal, black tahini, pecans, chestnuts, hazelnuts
- Wholegrains
  - Red, black and brown rice, red and black quinoa, wholegrain sourdough rye
- Drinks
  - Green tea, matcha, red wine

Prebiotics

- Like fertilizer for your microbiome
- Soluble, non-digestible fibres that naturally occur in fruits and vegetables
- Fermented by bacteria living in your large intestine to produce short-chain fatty acids like butyrate
  - Provide nutrition for cells that line gut
- Stimulate growth of healthy bacteria

Prebiotic Foods – Oligofructose/Inulin

- Chicory Root
- Dandelion Greens
- Jerusalem Artichoke
- Garlic
- Onions
- Leeks
- Asparagus
- Bananas
- Barley
- Oats
- Apples
- Cacao
- Flaxseeds
- Wheat bran
- Seaweed

Prebiotic Rich Foods – Galacto oligosaccharides

- Legumes
- Brassica family vegetables
- Fresh beans
- Beetroot
- Rye sourdough (if gluten tolerant)
- Sunflower seeds
- Pepitas
- LSA

Butyrate

- Short chain fatty acid
- In the gut:
  - Main fuel for colonocytes – the cells that make up the gut
  - Provides 70-80% of energy for colonocytes
  - Maintains intestinal barrier integrity in the colon and small intestine
  - Decreases endotoxin absorption
  - Enhances colonic motility
  - Maintain acidic pH in the gut
- Systemic
  - Enhances insulin sensitivity
  - protects brain cells
  - Anti-inflammatory

Butyrate

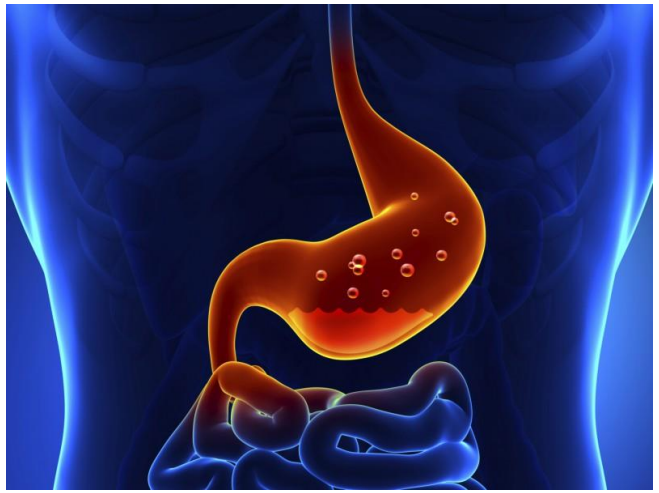
- Dietary strategies that decrease butyrate production to be AVOIDED
  - Western Diet
  - High fat diets
  - High protein – low carb diets
    - Decrease butyrate concentrations
    - Decrease populations of butyrate-producing bacteria

Butyrate

- To increase Butyrate levels
  - Feed butyrate producing microbes
  - Whole food high fibre diet rich in resistant starch and soluble fibre
  - Supplement prebiotics
    - Fructo oligo saccharides/Inulin
    - Partially hydrolysed guar gum
    - Psyllium seeds and husks
      - Ground seeds produce more butyrate than husks

Gut Acidity

- Optimal pH range 5-6.5
  - Western Diet acidity levels 7 up – too alkaline.
    - Encourages non beneficial gut bacteria to multiply
  - SCFA's produced by gut bacteria keep acidity levels up
    - SCFA's produced from fibre and prebiotic foods
  - pH also affected by transit time
    - The faster the stool moves the lower the pH
    - Low fibre diet => constipation
  - Can check with a CDSA



Probiotic Like Foods

- Bacteria found naturally in the human gut or in fermented foods such as yoghurt etc.
  - E.g. bifidobacterium and lactobacillus
- Referred to as ‘good bacteria’ or ‘helpful bacteria’.
- Research starting to show promising applications for specific strains of probiotics for specific disease.
- Potential future applications for disease management

Probiotics

- Introduce new species into the gut
  - On a temporary basis
  - Encourage growth of bacteria already resident
- Benefits include
  - They produce antimicrobial compounds
  - Keep out harmful bacteria that compete for nutrients and prebiotics
- Probiotics don’t need to survive to have an effect
  - Alter gut bacteria behaviour as they pass through

Probiotic Foods

- Good quality yoghurt
- Kefir
- Sauerkraut
- Microalgae
- Miso Soup
- Pickles
- Tempeh
- Kimchi
- Kombucha
- Natto






Probiotic Supplements – The Hype

- Large range found in local supermarkets
- Lack of research evidence to suggest these strains work
- Are they alive?
- Is it the right probiotic for you?

Animal Protein

- Some part of the protein we eat is always malabsorbed
  - i.e. it is not digested through the stomach and small intestine and reaches the large intestine.
    - Metabolised by bacteria that consume amino acids
    - Leads to putrefaction
      - Higher production of the gas hydrogen sulphide
        - Rotten egg smell!
- Hydrogen Sulfide
  - Impairs cytochrome oxidase, tissue metabolism, mucus formation and DNA methylation
  - Increased risk of colon cancer

Animal Protein

- Gut bacteria also produce ammonia from protein
  - At high levels in typical Western Diet
  - Ammonia
    - Destroys cells
    - Alters nucleic acid synthesis
    - Increases mucosal cell mass
    - Increases virus infections
    - Favours growth of cancerous cells over non cancerous cells
- High meat diet can double the ammonia concentrations in the colon
- Plant based diet can dramatically reduce levels of ammonia in the colon

Animal Protein vs Plant Protein

Harvard Study

- Sudden switch to vegan diet did not have immediate effect
- Sudden switch to high meat and cheese diet
  - Big changes overnight
  - Substantial increase in bacteria linked to heart disease
    - Bilophila wadsworthia

David et al (2014)

FODMAPS

F: fermentable
O: oligo-saccharides
D: disaccharides
M: monosaccharides
A: and
P: polyols

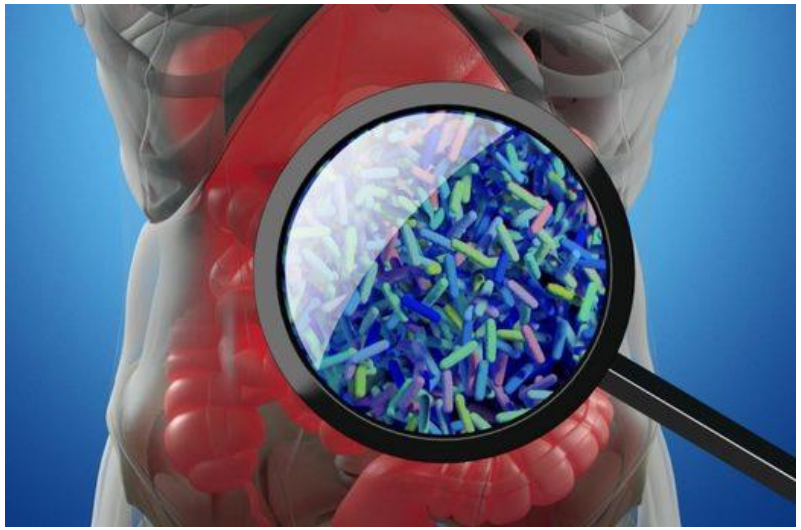
FODMAPS

- High prebiotic foods
- Fermented by gut bacteria
  - Increases small intestinal water volume
  - Increased colonic gas production
- Visceral hypersensitivity
  - If gut is inflamed, may not be able to tolerate high gas producing foods
  - Leads to IBS symptoms
    - Gas
    - Bloating
    - Discomfort
    - Diarhoea/Constipation

Foods high in FODMAPs				
Excess Fructose	Fructans	Lactose	Galacto Oligo	Polyols
Apple	Custard Apples	Buttermilk	Chickpeas	Apples
Boysenberry	Nectarines	Custard	Legume beans (e.g.	Apricots
Cherries	White peaches	Condensed milk	baked beans, kidney	Blackberries
Figs	Persimmon	Dairy desserts	beans, borlotti beans	Longon
Mango	Tamarillo	Evaporated milk	etc)	Lychee
Pear	Watermelon	Ice cream	Lentils	Nashi pears
Tamarillo	Artichoke	Milk	Nectarine	Nectarines
Watermelon	Chicory	Milk kefir	Pistachio nuts	Peaches
Asparagus	Garlic (and powder)	Milk powder	Cashews	Pears
Artichokes	Leek	Unripened cheeses	Oat milk	Plums
Sugar Snap Peas	Onion (and powder)	(e.g ricotta, cottage,	Soy milk	Cauliflower
Fruit Juices	Spring onion (white	cream, mascarpone)	Almonds	Mushrooms
Dried Fruit	part)	Yoghurt	Hommus	Snow Peas
High-fructose corn	Barley		Tahini	Sauerkraut
syrup	Rye		Ketchup	Isomalt (953)
Honey	Wheat			Maltitol (965)
				Mannitol (421)
				Sorbitol (420)
				Xylitol (967)

FODMAPs and the Microbiome

- Reduced numbers of bifidobacteria
- Reduced numbers of butyrate producing bacteria
- Increased numbers of Mucin-degrading bacteria



FODMAPs

- Not a long term solution
- Should only be followed strictly for 4-6 weeks
- Gradual introduction of each individual sugar group
- Reaction indicative of gut dysfunction
  - One big food reaction causing the rest?

How Diverse is Your Microbiome?

References

David LA, Maurice, CF, Carmody, RN, Gootenberg, DB, Button, JE, Wolfe,BE, Ling, AV, Devlin, AS, Varma, Y, Fishbach, MA, Biddinger, SB, Dutton, RJ and Turnbaugh, PJ 2014, 'Diet rapidly and reproducibly alters the human gut microbiome', *Nature,* vol. 505, no. 7484, pp. 559-563, viewed 22 June 2018, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3957428/

Resources

- The Probiotic Advisor Facebook page and education links

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