Lecture 5: Dietary Fibre & fats

DIETARY FIBRE

Dietary fibre is important in our diet, yet the term does not have an official definition.

- FSANZ — the fraction of the edible parts of plants or their extracts, or synthetic analogues, that are resistant to the digestion and absorption in the small intestine, usually with complete or partial fermentation in the large intestine.
- NHMRC — there is no single definition of dietary fibre, which is a component of all plant materials. What can be said with certainty is that most of the components of dietary fibre are carbohydrate in nature, lignin being an exception (lignin has an alcohol molecule at the end).

NB: Dietary fibres are **NOT** absorbed into the bloodstream. They are generally found within the plant cell wall.

Foods fortified with Fibre

Australians have low fibre intakes.

- Thus FSANZ allow nutrient content claims under the Food Standards code, e.g. “high fibre” labelling
- although it is fortified, it does NOT provide a range of fibre types. Also to keep in mind, these are processed foods that are being fortified with fibre, thus are still not as healthy as whole foods.

NB: **Whole and minimally processed foods are preferred.**

Soluble fibre fortification

- soluble fibre is more likely to be added to processed foods, e.g. inulin, maltodextrin, polydextrose

TYPES OF DIETARY FIBRE

1. Insoluble fibre
2. Soluble fibre
3. Resistant starch

	Characteristics	Types	Examples
INSOLUBLE FIBRE (from plant cell wall; often have fibrous appearance)	• insoluble in water • draws in water to stomach (filling) • bulks stools because it holds water • promotes healthy flora in the bowel (through providing prebiotics to the gut microbiota)	• cellulose • hemicellulose • lignin	• wholegrain cereals, e.g. wheat • fruits and vegetables (especially skins) • seeds and nuts (especially skins) • legumes

SOLUBLE FIBRE (tends to wrapped around inside the cell wall, around the insoluble fibres to give structure, or when the plant is damaged)	• dissolves in water or forms a gel • slows stomach emptying (filling) • reduces blood cholesterol (through bile excretion) • helps regulate blood glucose levels through slowed digestion	• pectins • gums • mucilage	• fruits and vegetable • oats, barley • seeds • beans, lentils, peas (not obviously fibrous foods; more internally in the food)
RESISTANT STARCH (forms in some unprocessed foods or formed by cooking and cooling)	• starch that is NOT digested in the small intestine (resistant to digestion) • high proportion of amylose (as compare to amylopectin) • undergoes anaerobic fermentation in the bowel —> produces short chain fatty acids SCFA —> protects bowel cells • decreases bowel pH —> allows bacterial growth, possible reduction in absorbing carcinogens	• **RS1**: resists digestions because it is bound within the fibrous cell walls (e.g. grains, seeds, legumes) • **RS2**: in some starchy foods (e.g. raw potatoes, green unripe bananas) • **RS3**: formed when certain starchy foods are cooked and then cooled. The cooling turns some of the digestible starches into resistant starches via retrogradation process (e.g. the cooking and cooling of potatoes and rice) • **RS4**: a man-made, formed via chemical process (e.g. bread)	• unprocessed wholegrains, e.g. barley • unripe fruits, e.g. unripe bananas • lentils • cooked and cooled potatoes and pasta • added to some foods, e.g. bread

RECOMMENDATION (per day): 2 medium size fruits, 5 serves of vegetables; 4-7 serves of carbohydrates (depending on size)

Prevention of Disease — OBESITY

Dietary fibre is thought to reduce risk of obesity through:

- low energy density foods (unavailable carbohydrate)
- satiation (high water content, slows digestion)
- may affect a number of hormones (e.g. Ghrelin — tells us when we are hungry; Insulin)

- reduces the likelihood of eating high fat, high sugar (energy dense) foods, which are likely to lead to weight gain

Prevention of Disease — CANCER

Dietary fibre is thought to reduce risk of bowel cancer.

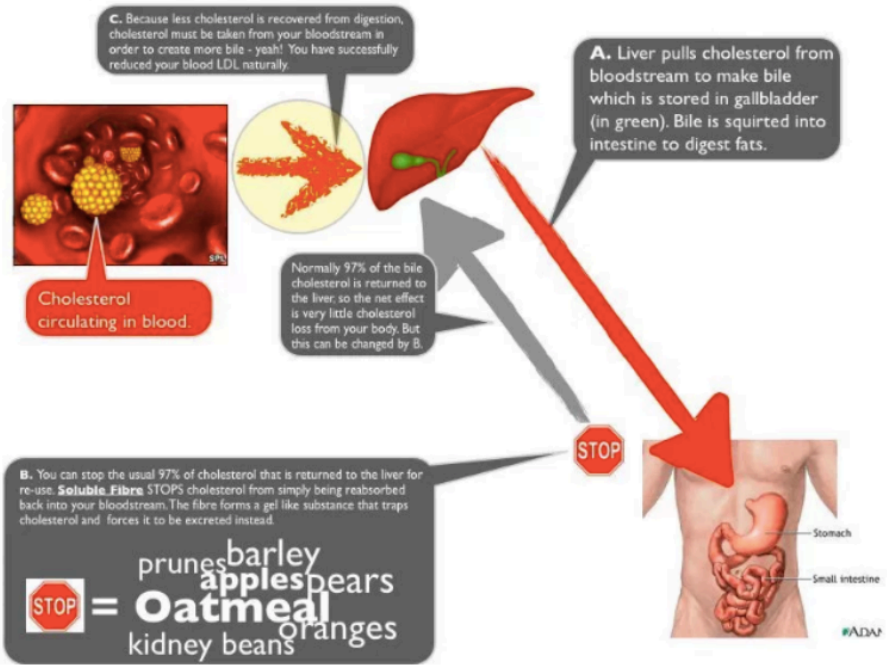
- High fibre intake reduces risk due to following possible mechanisms:
    - high fibre reduced transit time/motility time for foods to be digested and passed through the colon. This reduces colonic exposure to carcinogens.
    - fibre is also able to bind to toxins or mutagenic metabolites
    - fibre can also change the pH of the bowel — lower faecal pH prevents bile acid conversion to secondary acids (which are possible carcinogens)
    - the availability of dietary fibre can alter bacterial fermentation (since gut bacteria would have food— prebiotics— to produce SCFA, e.g. butyric acid/butyrate)
    - lowers insulin resistance (high levels of insulin are associated with bowel and breast cancers)
    - reduced risk through better weight control

Prevention of Disease — HEART DISEASE

Dietary fibre is thought to reduce risk of obesity through:

- 2011 NHMRC evidence shows 3 meta analyses report that cereal fibre has protective effect against heart diseases (~25% reduction of coronary death risk for each 10g increment in cereal fibre)
- most studies focus on oats and barley, but also a wider range of wholegrain foods; fruits and vegetable intake and risk of heart disease has also been observed

Possible mechanism for soluble fibres to lower LDL cholesterol (decrease CVD)



Prevention of Disease — TYPE 2 DIABETES

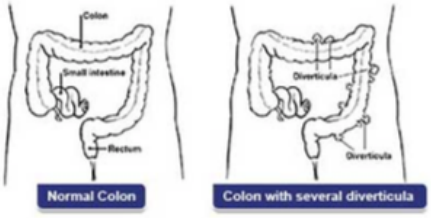
Dietary fibre is thought to reduce risk of obesity through:

- 2011 NHMRC evidence shows cereal fibre (especially 3 serves a day of wholegrains) is associated with reduced risk of type 2 diabetes
- this can be due to the slowed digestion, lower post-prandial glucose response and lower circulating insulin and other hormones (lower circulating insulin, thus less absorption of glucose into blood)

DEFICIENCY AND DISEASE

Consequences of Low dietary fibre intake

- **constipation** (if eat enough dietary fibres, the stool won't be sitting inside the bowels for too long which dehydrates it)
- **haemorrhoids**
- **exacerbate IBS symptoms (mixed roles)**
- **bowel cancer**
- **diverticular disease** (diverticular "pockets" forms from pressure of having hard stools pushing it over long periods of time. Most of the time it does not affect the individual, however they can get inflamed some times, thus acute pain)



DIETARY FATS AND OILS

Fats are categorised in terms of their molecular structure.

	Characteristics	Examples	Watch out
SATURATED FATS (only single C-C bonds) E.g. - Stearic Acid 18:0	- only C-C bonds; thus is a very straight molecule - increases LDL cholesterol in the body (thus increases CVD risk) - maybe it is the source of which saturated fats come from that is more harmful (e.g. from fried foods, fatty meat, as compared to dairy and coconut oil) NB: replacing saturated fats with monounsaturated fats can improve blood lipid profiles (NHMR 2011)	- predominant in animal foods: dairy, meat (including skin) - 2 plant oils: palm oil, coconut oil	• limit saturated fat • mediterranean diet (high in fish oils, dairy) appears to be protective • saturated fat from plants and dairy may be less worrying than from highly processed foods and from fatty meats

UNSATURATED FATS

- **monounsaturated**
- **polyunsaturated**

(have one or more double C=C bonds)

There are also essential and non-essential fatty acids

Essential fatty acids: body needs to consume

- Omega 6 (Linoleic)
- Omega 3 (ALA, EPHA, DHA)

- we tend not to have enough omega 3
  - from plants: ALA
  - from marine: EPA, DHA

Recommendation

- **Plant based ALA: 1g/day**
- **Marine based EPA & DHA: 250-500mg/week**

Non-Essential fatty acids: body can synthesise

- Omega 9 (Oleic)

MUFA:

- Oleic Acid 18:1, n-9

PUFA:

Omega 6

- Linoleic Acid 18:2, n-6

Omega 3

- alpha-Linoleic Acid 18:3, n-3 (ALA)
- eicosapentaenoic acid (EPA)
- docosahexaenoic acid (DHA)

MUFA:

- olive, canola, peanut oils

PUFA

ALA

- nuts and seeds (chia, flaxseed, pecan, hazelnuts)
- fats and oils (flaxseed, canola, soybean, vegetable, olive oil)

EPA and DHA

- canned fish (highest): sardines, salmon, tuna

ESSENTIAL FATTY ACIDS: Omega 3 and Omega 6

Fat-soluble Vitamins A, D, E, K can be found in fatty foods.

Ratio of Omega 3 : Omega 6 may be important.

more omega 3 leads to more arachidonic acid concentrations, important for brain growth particularly in infants.

e.g. in providing protection against cardiovascular disease, by:

- reducing triglycerides (TGs)
- decreasing LDL cholesterol
- increase HDL cholesterol
- thinning the blood (reducing blood clot formation)
- reducing inflammation in the body

It is only Grade D evidence (no compelling, strong evidence yet)—"consumption of long chain PUFA is associate with reduced mortality from CVD", NHMRC 2011.

Effects of n-3 and n-6 deficiency (not common in Australia)

- rough, scaly skin, dermatitis, increased transepidermal water loss, reduced growth

<table>
<tr>
<td rowspan="2">TRANS FATS

(is naturally occurring and can be industrially made through hydrogenation or partial hydrogenation)</td>
<td>- H atoms are on opposite sides on C=C, have straight shape
- solid at room temperature
- most worrying dietary fatty acid in terms of risk factors
- increases CVD death, as strong evidence shows it increases LDL levels

<u>Recommendation</u>
• contribute <1% of energy
• aim to eliminate trans fatty acids, AVOID TRANS FAT</td>
<td>- USA: Crisco was used in biscuits and pastries as solid fats (mandatory labelling of trans fat on food products 2006, phase out 2015, banned 2018)
- Denmark: <2% trans fat in food</td>
<td>- small amount in some some animal foods (e.g. butter, meat)
- frying fats (pastries, meat pies, sausage rolls, fried meat, chips)
- in some foods that use margarines (store made biscuits, cakes, muffins)

NB: fried foods are the most concerning</td>
</tr>
<tr>
<td colspan="3">Trans Fat intake in Australia
- FSANZ: Australians eat half of WHO recommendation, 0.5% energy from trans fatty acids — which is good!
- manufacturers are not required to label Trans Fat, unless making a nutrient content claim about PUFA or MUFA

Criticisms about Australia’s policy
- 86% of food samples taken had concentrations below 2g/100g fat (i.e. 14% were higher than that)
- TFA is not labelled
- majority of suppliers to fast food restaurants didn’t respond to survey (only 22 out of 52 responded)
- only 90% of Australians meet WHO guidelines
- e.g. indigenous people, eating margarine that contains 5% trans fat (maybe they didn’t have other food supply options) but this would continue the excessive risk of heart disease amongst indigenous people</td>
</tr>
</table>