



March 2014

Focus
on fibre



A high fibre diet can...

- Improve immunity
 - Fight inflammation
 - Protect from obesity
 - Prevent diabetes
 - Lower risk of heart disease
 - Guard against colorectal cancer
 - Boost digestive health

And...

- Does dietary fibre protect against asthma?





Why We Need to Focus on Fibre... Now!

Australia's need for the health benefits associated with high fibre diets has never been greater – consider the following:

\$100 BILLION

Obesity, heart disease, stroke, type II diabetes and cancer account for approximately **two thirds of the \$100 billion plus** expended each year on health



Three in five adults (**61%**) and one in four children (**25%**) are either overweight or obese



The burden of type II diabetes is expected to surpass cancers as the leading cause of disease in Australia by **2023**

Poor diet is considered a factor in **56%** of all deaths in Australia each year¹



As the report will describe, optimal fibre intakes have been shown to reduce the risk of, and in many cases offer protection against, some of Australia's most common lifestyle related diseases^{2,3}.

In addition, ground-breaking new research shows dietary fibre, via the action of beneficial gut bacteria, plays a role in the body's immune responses with Australian scientists suggesting low fibre 'Western' diets may have contributed to the rise in conditions such as asthma⁴.

Dietary Fibre – A Disease Fighter

Amid the plethora of health claims made almost daily for new, often expensive products, it is perhaps not surprising that dietary fibre has lacked attention. However, unlike many if not all of these new products, dietary fibre has been independently shown in high quality scientific research across many years to reduce disease risk.

The list of health benefits for dietary fibre is impressive and growing:

Reduced Inflammation

Dietary fibre has been recognised for some time as having anti-inflammatory benefits^{2,5} with the dietary metabolites (or by-products) of fibre fermentation by gut bacteria, namely Short Chain Fatty Acids (SCFAs), rapidly emerging as a major player in immune function^{4,6} and potentially having a role in the prevalence of inflammatory disease in Westernised countries⁶.

A recent review noted that the Short Chain Fatty Acids resulting from the fermentation of dietary fibre:

"...are well known for their anti-inflammatory functions..." and "...are potent anti-inflammatory mediators..."⁶

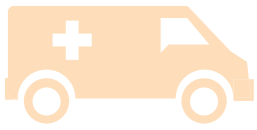
Obesity Protection

According to the World Health Organisation's global report, "Diet, Nutrition and the Prevention of Chronic Disease", only one dietary component had the "Convincing Evidence" required to demonstrate a protective effect against weight gain and obesity – and that was dietary fibre⁷. Australia's peak health authority, the National Health and Medical Research Council, also specifically identified the importance of dietary fibre in reducing obesity;

"Increasing dietary fibre intakes have been linked to lower rates of obesity..."³

22%

The amount high fibre consumers lowered their death risk compared to low fibre consumers in a recent review²¹



“Lower dietary fibre intake is found to be associated with a higher prevalence of cardio-metabolic risks including metabolic syndrome, cardiovascular inflammation, and obesity...”²⁶

Diabetes Prevention

In regard to the prevalence of diabetes, dietary fibre plays a significant protective role, independent of other dietary factors, with a comprehensive scientific review of fibre's health benefits stating:

“High levels of dietary fibre intake are associated with a significant reduction in the prevalence of diabetes...”²

Lower Risk of Heart Disease

Diets high in dietary fibre are acknowledged as offering a significant reduction in risk for both heart disease and cardiovascular disease with a recently published systematic review and meta-analysis confirming that:

“Diets high in fibre...are significantly associated with lower risk of CHD (Coronary Heart Disease) and CVD (Cardiovascular Disease)...”⁸

“Increasing fibre intake lowers blood pressure and serum cholesterol levels.”²

Guard Against Colorectal Cancer

The World Cancer Research Fund (WCRF), an ongoing global initiative reporting on diet and lifestyle factors and cancer risk provided an update in 2011 in which dietary fibre's ability to protect against colorectal cancer was upgraded from probable to convincing⁹.

The updated WCRF report included a meta-analysis that revealed a 10% decrease in colorectal cancer risk for each 10g/day increase in dietary fibre¹⁰. The WCRF report also commented upon the consistency of the evidence showing fibre's protective effect.

Dietary fibre was the only dietary component adjudged by the WCRF as having convincing evidence for colorectal cancer protection⁹.

Bowel cancer is the second most common cancer in Australian men and women³² with 12,500 new cases diagnosed each year³¹. Being active, maintaining a healthy bodyweight and eating plenty of high fibre fruits and vegetables can reduce the risk³¹.

Boost Digestive Health

Dietary fibres can increase mass in the large bowel (contributing to faecal bulking), dilute potentially toxic products such as ammonia, phenols and hydrogen sulphide that can result from protein fermentation and reduce their impact on gut tissues².

Also, fibres which are fermented by the bacteria in the large bowel lead to the production of short chain fatty acids (SCFA), primarily acetate, butyrate and propionate, which have multiple beneficial effects on colonic tissues and lower luminal pH, providing an environment more conducive to growth of beneficial bacteria².

Dietary fibre may also play a preventative and potentially therapeutic role in a range of bowel related disorders including diverticulitis, constipation and haemorrhoids. Certain fibres may assist with management of Irritable Bowel Syndrome and be helpful for some individuals with Inflammatory Bowel Disease².



8th

Australia's global ranking for highest colorectal cancer incidence³³

What is Dietary Fibre?

Dietary fibre, found only in plant foods, escapes digestion in the small intestine and reaches the large intestine (colon) where it is either partially or completely broken down by the resident bacteria to promote health and wellbeing¹⁴.

Types of Dietary Fibre

There are three main types of dietary fibre:

Soluble Fibre

Gel-like fibres that help lower blood glucose and can help reduce LDL cholesterol²

Insoluble Fibre

Bulking fibre to 'keep things moving'²

Resistant Starch

Starch that resists digestion in the small intestine to reach the bowel where it produces a range of beneficial changes in the colon¹⁵

Mix It Up!

When it comes to fibre the best advice is to mix up the types of fibre – to obtain the benefits of all three main types of fibre – soluble, insoluble and resistant starch.

“The evidence suggests that the three main types of fibre, soluble, insoluble and resistant starch, offer a range of important health benefits and so we should aim to consume a combination of different types of fibre daily”.

Dr Tony Bird, CSIRO¹⁶



Dietary Fibre and the Immune System – Emerging New Connections

The idea that dietary fibre could have an impact on the immune system, certainly within the gut itself, is not new¹¹. However, with advances in scientific technologies, researchers are now able to explore mechanisms whereby dietary fibre may play a role in immune responses beyond the gut⁴.



The relatively recent discovery of a class of receptors (called G-protein coupled receptors) with marked effects on the immune system that have been shown to specifically bind to Short Chain Fatty Acids provides evidence (in mice) for a link between fibre in the diet, the generation of Short Chain Fatty Acids (via bacterial fermentation) and immune responses¹².

As a result of this work, authors of the research stated:

“The fermentation of fibre produces large amounts of SCFAs...we believe that the amount of SCFA...is critically important for immunoregulation.”

Unlocking the Health Power of Dietary Fibre

It is rapidly emerging that Short Chain Fatty Acids (SCFAs), produced via the fermentation of dietary fibre by the gut bacteria, are fundamental to understanding some of the key health giving properties of dietary fibre.

Indeed, a deficiency of SCFAs as a result of low fibre Western diets...

“may affect the pathogenesis of a diverse range of diseases, from allergies and asthma to cancers, autoimmune diseases, metabolic diseases, and neurological diseases.”⁶

Certainly the incidence of both inflammatory and autoimmune diseases has increased dramatically in Westernised countries over the past several decades in tandem with lower dietary fibre intakes⁶.



What Are Short Chain Fatty Acids?

Short Chain Fatty Acids (SCFAs) arise primarily from the bacterial fermentation of dietary fibre – carbohydrates that escape digestion in the small intestine and reach the large bowel⁶.

‘Fermentation’ refers to a variety of reactions and metabolic processes performed on dietary fibre substrates by the resident bacteria under anaerobic conditions, resulting in the production of SCFAs along with gases and heat²⁹.

The primary SCFAs are acetate, propionate and butyrate with population studies indicating acetate is the most prevalent followed by propionate and butyrate at the ratio of 3:1:1. However, different fibres can elicit a different ratio of SCFAs. Resistant starch, for example, is considered the best source for butyrate production via both in vitro and in vivo studies compared to other forms of dietary fibre⁶.

In addition to the substrate source (fibre type), the production of SCFAs is also influenced by the number and type of bacteria present in the colon as well as the gut transit time³⁰.

The role of the SCFAs in the body is extensive and growing – some major bowel benefits include:

- Acting as nutrients (energy source) for cells in the colon
- Modulators of colonic pH, cell volume and other functions associated with ion transport
- Regulators of proliferation, differentiation and gene expression³⁰.

However, the physiological roles of SCFAs are broader than a local effect on the gut and on digestive function; it is rapidly emerging that SCFAs play a major immunological role both systemically and locally in the gut⁶.



Can Dietary Fibre Protect Against Asthma?

A New European Study Identifies Dietary Fibre as Protective²⁷

Researchers at Lausanne University Hospital put mice on a standard diet with four percent fermentable fibres (fibres that can be digested by the gut bacteria) or gave them low-fibre food with merely 0.3 percent fermentable fibres.



When the mice were exposed to an extract of house dust mites, the mice with the low-fibre food developed a stronger allergic reaction with much more mucus in the lungs than the mice with the standard diet.



The protective effect is believed to be the result of a multi-level reaction chain. First, the fibres reach the large intestine, where they are fermented by bacteria and transformed into short chain fatty acids. These acids then enter the bloodstream and influence the development of immune cells in the bone marrow.

Interestingly, when two key short chain fatty acids initially identified in the above trial (propionate and acetate) were added to the drinking water of a second set of mice, their allergic lung inflammation in response to dust mite extract was similarly reduced – strongly suggesting it is the action of the short chain fatty acids (derived from the fibre) that is responsible for the protective effect observed.

As a result of these findings, the researchers stated:

“Our results show that dietary fermentable fibre and SCFAs can shape the immunological environment in the lung and influence the severity of allergic inflammation.”²⁷



Do The Findings Translate to Humans?

The research team pointed out the particular aspects of the immune system under investigation in the study are “virtually indistinguishable in mice and humans”. That said, there are still unanswered questions and the team plans to undertake clinical trials²⁸.

Asthma Incidence - Hygiene or Diet Hypothesis?

In 1989 the ‘Hygiene Hypothesis’ was first put forward to help explain the rise in asthma and atopic disorders in Western countries and further supported again in 2000¹³. Simply put, it suggests that excessive cleanliness in the environment has led to a decrease in the number of infectious stimuli needed for proper development of the immune system⁴.

The emergence of a dietary connection to immune response (via fibre fermentation and the production of SCFAs) brings a different perspective.

It may well be that diet and specifically the fibre content of the diet is the key. Also, in countries like Japan where there is a high level of hygiene, there is much less asthma than in Australia – which may link to their intake of rice and beans plus other dietary components that increase SCFAs⁴.

Dietary Fibre may reduce the risk of premature death²¹



How Much Fibre?

The National Health and Medical Research Council in its Nutrient Reference Values report³ developed a set of Adequate Intake figures for dietary fibre that are designed for general good health (see table below).

NHMRC Adequate Intake Recommendations for Dietary Fibre

Men

Adequate Intake(g/day)

1-3 years	14
4-8 years	18
9-13 years	24
14-18 years	28
19+ years	30

Women

Adequate Intake(g/day)

1-3 years	14
4-8 years	18
9-13 years	20
14-18 years	22
19+ years	25
Pregnancy	25 - 28
Breastfeeding	27 - 30

Importantly, the NHMRC's Nutrient Reference Values report also highlighted the important role fibre plays in reducing disease risk.

“Increasing dietary fibre intakes have been linked to lower rates of obesity, cardiovascular disease, diabetes and certain cancers.”³

The NHMRC provided specific higher recommendations to reduce disease risk – called Suggested Dietary Targets.

The Suggested Dietary Target for fibre is given below:

Suggested Dietary Target for Fibre to Reduce Disease Risk³



Men
38 grams/day



Women
28 grams/day



Fibre-rich legumes, including pulses and soy products remain an uncommon component of Australian children's diets²⁴



"A high level of fibre intake has...disease-reversal benefits"²

Current Fibre Intake

Adults

Up-to-date fibre intake figures for adults are imminent with further results of the Australian Health Survey due for release later in 2014¹⁷. In the absence of the new health survey results for fibre, datasets currently available for estimating adult fibre intake include the outdated 1995 National Nutrition Survey along with smaller studies which are also dated¹⁸.

Given these limitations, fibre intake figures generated from these datasets may be at best indicative and considerable caution should be exercised in their use. These caveats notwithstanding, the data suggest adult men may be consuming approximately 27grams/day while women may be consuming 21grams/day of fibre¹⁸. Both figures, while approaching the Adequate Intake level fall well short of the Government's Suggested Dietary Target for fibre at 38grams/day for men and 28grams/day for women – fibre intake levels at which the potential for disease risk reduction is deemed possible³.

Recent smaller surveys of whole grain consumption indicate Australian adult intake declined by 20% from 2009 to 2011. In 2011 only one in four Australian adults was meeting the current guidelines of 'mostly whole grain'²³. Whilst it is possible to obtain dietary fibre from other food sources, public health messages to increase whole grain consumption are warranted to help ensure optimal total fibre intake.

An additional question regarding current adult fibre intakes emerges from Australian Health Survey results that have been released for fruit and vegetable intake with the finding that: "...only 5.5% of Australian adults had an adequate usual daily intake of fruit and vegetables."³⁴

Children

In children, the 2007 Australian National Children's Nutrition and Physical Activity Survey revealed that the mean usual intake for fibre was generally at or above the Adequate Intake recommendation for fibre¹⁹.

However, the fact that the same children's survey also found poor intake for fruit and vegetables (only 1-2% of older children consumed the recommended 3 serves of fruit [juice not included] and 1-11% of older children met the guideline for vegetables ([potatoes included])¹⁹, indicates there is still much work to be done to increase these key fibre foods in the diets of Australian children.

A reanalysis of the 2007 Australian National Children's Nutrition and Physical Activity Survey also revealed that the intake of fibre-rich legumes, including pulses and soy products, was low with only 5-7% of children in the survey consuming these foods²⁴.



Where To Find Dietary Fibre

Soluble Fibre

Whole grains

Oats, barley, rye and grain foods made with these ingredients like breakfast cereals, breads.

Legumes

Lentils, red kidney beans, chickpeas, baked beans.

Other

Fruits, vegetables, nuts, seeds.

Insoluble Fibre

Whole grains

Most whole grains e.g. whole wheat, brown rice, rye, barley.

Wheat bran, rice bran, bran based grain foods, whole grain and wholemeal breads.

Other

Pastas, crispbreads, and noodles. Nuts, legumes, couscous and skins on fruit and vegetables.

Resistant Starch²²

Grains e.g. millet, barley, raw oats (not rice), banana (firm), legumes (lentils, soy), pasta, egg noodles, Asian noodles, bread, baked beans, fibre increased white bread (with Hi-maize).

Adapted from GLNC (ref 14)

Chickpeas

Soluble & Insoluble Fibre

Mixed Beans

Soluble & Insoluble Fibre

Oats

Soluble & Insoluble Fibre

Seeds

Soluble Fibre



Putting it into Practice – A High Fibre Meal Plan²⁰



Breakfast

2 fortified whole grain wheat biscuits with 1 cup low fat fortified soy milk, ½ cup sliced strawberries, a sprinkle of chia seeds

1 slice wholemeal bread with peanut butter and honey



Snack

1 banana

150g tub low fat, fruit yoghurt



Lunch

Wholemeal sandwich with egg, lettuce and mayonnaise

½ cup blackcurrant juice



Snack

2 crispbread with 40g low fat cheddar cheese and tomato



Dinner

Tofu curry with vegetables (made with 100g tofu, broccoli, capsicum, carrot and mushrooms, sprinkled with sesame seeds) served with 1 cup cooked brown rice



Snack

125ml custard with ½ cup tinned peaches

**Total Fibre =
34 grams**

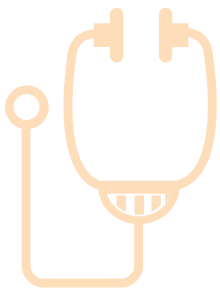
Adapted from Reid et al (ref 20)

Tips to Boost Dietary Fibre Intake

1. Choose grain based and wholemeal breads.
2. Introduce the family to brown rice and wholemeal pasta.
3. When buying cereals, look for wholegrains and fibre increased varieties. Products with wholegrain ingredients at the beginning of the list (wheat, brown rice, barley, oats, rye, millet, sorghum or triticale etc) are a good choice and look out for words such as whole, wholegrain, mixed grain, cracked, flaked or kibbled next to the name of the grain along with 'High/Excellent source of fibre'.
4. Add legumes such as kidney beans, lima beans, soybeans, chickpeas, dried peas and lentils to soups, casseroles, salads and sauces. Baked beans on wholegrain bread is a tasty and convenient high fibre option.
5. Sprinkle chopped fresh or dried fruits, wheatgerm or seeds on breakfast cereal.
6. Try a handful of dried fruit and nuts as a snack or add some nuts to a stir-fry.
7. Instead of a milkshake, try a fruit smoothie made with a banana or other fresh fruit. Add in rolled oats as an additional fibre boost.
8. Eat unpeeled fruits and vegetables wherever possible as the skins are a valuable source of fibre.
9. Choose fresh fruit more often than juice to optimise fibre intake.
10. Look on the nutrition panel of food products and choose those which provide at least 2 grams of dietary fibre per serve.

19%

The reduction in risk of Cardiovascular Disease for each 10gram/day increase in fibre found in a recent review²¹



Fibre and Satiety

A recent systematic review found that a diet high in a mixture of fibres had a satiety-enhancing effect while most acute fibre studies looking at satiety and/or reduced food intake did not show an effect²⁵.

The review did reveal there is evidence that beta-glucan (from oats or barley), lupin kernel fibre, rye bran and whole grain rye may decrease appetite more frequently than other fibre types²⁵.

The authors suggest further research and perhaps more sensitive satiety measurement techniques are required to provide a physiological explanation for epidemiological findings that show higher fibre and whole grain intakes are associated with lower body weights and the prevention of weight gain compared to diets low in fibre and whole grains²⁵.

Fibre and the Future – Commentary

Increasing the consumption of dietary fibre has been advocated by public health authorities for good reason. The evidence supporting a preventative and in some cases, therapeutic role for dietary fibre in relation to a host of common diseases (many of which are now understood to have an inflammatory basis) is well documented.

The interplay between fibre, gut bacteria, metabolites (SCFAs) and the immune system (such as allergic airway inflammation) now presents as a new and exciting horizon for dietary fibre research.

The rise in asthma, allergy and autoimmune diseases in Western and Westernised countries parallels dietary changes including a reduction in dietary fibre and molecular links have been identified between dietary fibre's metabolites and the immune system.

Well-designed research studies are now required to confirm and clarify the role that fibre and SCFAs can play and in doing so novel dietary approaches to disease prevention may emerge.

In light of these developments and the solid evidence already showing its benefits, calls to increase dietary fibre across the population should not only continue they should be reinvigorated.



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